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ENGINEERING NEWS-RECORD

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Common Sense vs. Armaments

WARS recur at fairly regular intervals but it still remains a question whether the intervals are governed most by the time required for economic recovery or by the time required for the horror of the last war to wear away. The first controls governments, which are impersonal, and the second individuals, and since governments persist and individuals pass away we find that preparations for war increase as the human protest against war vanishes in the mist of memory. But we gain sense in this world. We learn that even human nature changes, that man does grow more reasonable and that nationalistic aspirations can be restrained. The Harding-Hughes arms reduction conference had a success that confounded those who still held to the theory that war breeding competition was inevitable. It did not make war impossible, but it did envelop some of the machinery of war in an atmosphere of common sense. Now it appears that some more of the same treatment is indicated, and President Coolidge has moved to apply it. As before the cynics and the critics will cavil, but let them! Common sense becomes more and more powerful as man grows older.

The Moffat Tunnel

A UNIQUE enterprise reaches the first stage of its completion this week, with the holing through of the pilot heading of the Moffat tunnel, scheduled for Feb. 18. One of the longest mountain tunnels of America, and in many respects among the most difficult, it is even more notable for being built by public money, though intended to be used by a railroad corporation. Only through this unusual combination of interests was it possible to finance the long-hoped-for piercing of the great mountain masses which block railway communication to the west, in the long stretch lying between the Overland Trail on the north and the gorge cut by the Arkansas River in the south, the passes of the Union Pacific and the Rio Grande railway lines. Denver had been left to one side by the transcontinental routes, and though Moffat dreamed of a direct line westward he failed to create it. The hope that his boldly planned railway could carry out the difficult piece of tunneling necessary to make it a dependable through route was wrecked by bankruptcy. But the city felt that the undertaking was essential to its progress, and so, after many trials, it organized a tunnel benefit district to finance and execute the work. It is true that there is a purely municipal element in the tunnel; a smaller auxiliary heading which is to become a water-supply conduit to bring water to Denver from the headwaters of the western slope and which was utilized as advance heading to speed the construction of the main tunnel. But this at best is incidental; essentially the Moffat tunnel undertaking represents a remarkable piece of co-operation between a public authority and a railway, designed to serve the joint advantage of the railway company and the communities which it will most directly benefit. Public financing of necessary utility investments has been much discussed in the past in an academic way. Here it finds a concrete exemplification.

Dwarfing the White House

SOME self appointed protectors of the city beautiful have become all worked up over the "dwarfing of the White House" by a new building on the north side of Lafayette Square in Washington. Their protest to the President has been circulated widely through the press and those who do not know Washington may be led to believe that the hand of the ruthless realtor is all set to destroy the capital city. We hold no brief for the realtor; indeed it has been our oft expressed notion that he ought to be legislated out of business. But in this case the reformers, as is their habit, seem to have overplayed their hand. It is a quarter of a mile from the White House to the north side of H Street where the new building is to rise, a quarter mile covered with the trees and shrubs of the White House grounds and Lafayette Square and intersected by the broad pavement of Pennsylvania Avenue. Further than that Washington buildings are kept to low height by law. It is inconceivable that buildings here could materially affect the setting of the White House. Unless we are prepared to turn Washington over to the government entirely and then to establish building beauty by fiat it is hard to see how the situation in this particular locality could be improved.

Wider Road Rights-of-Way

SLOW progress is being made in convincing the public and the lawmakers that the four-rod road has had its day for main thoroughfares. Something has been done in the way of legislation and executive order to secure wide right-of-way for individual roads and in a few states for main roads in general, but the idea stays with the people that the old 66-ft. road zone meets all necessities for public road widths by and large. As a consequence of this creed, main roads today in new locations are being narrowed down to rights-of-way established in an era of horse-drawn vehicles. An example is offered by recent main road locations across the meadows which separate the cities of the northern New Jersey metropolitan district tributary to New York City from which road tunnels and bridges of vast traffic capacity will be completed in five to seven years. Today the meadow land right-of-way can be purchased at a fraction of its selling price in ten years and by then the demands of traffic will compel its purchase at any cost. There was excuse for the old road surveyors who swung their Gunter's chain across the road and set a fence

line stake at each end. They could not conceive of a different vehicle than the cart nor of traffic intensity exceeding the congregation of people at a county fair or on circus day. Traffic growth can now be figured ahead with reasonable approximation and any least figure which can be contemplated in ten years for these New Jersey roads makes consideration of less right-of-way width than 100 ft., absurd. There is no excuse for the road builder who today fails to vision and plan something of the heritage which the future has a right to expect from present-day planning. It is his duty to carry this vision and plan on to the people and their representatives in legislature.

Going Too Far

THE National Fire Protection Association proposes to organize a fire prevention clean-up week, to be held the country over in April. Most of us will not welcome the announcement. The "week" business has been pretty well done to death, and a vigorous reaction is about due. The public has been bored, victimized and irritated by the various types of enthusiasts who have instituted weeks: national apple week, mother's week, own-your-own-home week, Red Cross week, thrift week, and an endless succession of similar nuisance campaigns, and a spring clean-up week even though conducted under the auspices of the National Fire Protection Association runs the risk of being the last straw. We concede the worthiness of the motive and the excellent character of the organization back of the new movement. Few societies in the country are entitled to more esteem and appreciation than the National Fire Protection Association for work that benefits the public and the individual. But good character and good motives are not enough in the present instance. The association already has laid a burden on its fellow citizens and taxed their patience with one "week," namely, fire prevention week, which is duly run off each October, and in now undertaking to preempt another one of the limited 52 weeks of the year with an exhortational campaign it is going a good deal too far.

Four Hundred Questions

HIGH water mark in questionnaires is reached with the one just circulated by the Buffalo chapter of the Isaak Walton League of America. This is a 22-p. printed pamphlet entitled "Questionnaire Relative to the Buffalo Water Supply for Domestic Consumption," and it has upward of 400 questions to be answered. The preface contains several instructions to those about to answer—"Please read carefully before answering questions. . . . It is essential that answers be made as complete and accurate as possible. . . . Please do not just say 'yes' or 'no'. . . . Your kind co-operation is most urgently requested for this move is one to assist in promoting the present and future public's health for Humanity's sake." And then follow the questions, four hundred odd of them, ranging all the way from mere gazetteer data—as the length, etc., of Lake Erie—to expert opinion on the best method of sewage treatment for Buffalo and to requests for descriptions, costs, etc., of sewage-works "near Buffalo" and with increasing geographical range until one reads "in the United States." "What constitutes domestic sewage?" "Should the city plan for the future health of the community?" "Prepare sketch showing water currents . . . along different points of the waterfront." "What are the effects and purposes of a filtration plant?" These are a few of the questions. Down toward the end, in deference to old Isaak of the trout brook, there are one or two questions about fish, but the major inquisition is a complete delving into the bases of sanitary science and its application to Buffalo. Of what earthly use is such a questionnaire, and under what perverted view of public service does a society so waste its time and the time of those who will read—for certainly few will answer—such a document?

An Age of Great Bridges

ANOTHER huge bridge project is placed before the world with the announcement of the studies for a crossing over the Kill van Kull, to be built by the Port of New York Authority. An arch of 1,600 ft. or more is planned, closely rivaling the large arch of the Sydney Harbor bridge now being built in Australia, 1,650 ft. long. The world's longest suspension bridge, the Camden bridge, is six months old, taking the record from the Bear Mountain bridge, built only two years before; and already another structure of enormously greater magnitude is preparing for construction, the Port Authority's 3,500-ft. suspension span at Fort Lee. We are entering a new era of magnificently great bridges, it appears.

America is not alone in the advance. Australia's contribution has just been mentioned, and Europe is moving forward with equal energy under the demands of the new times. French engineers are constructing concrete arches of four, five and six hundred feet span. In Germany, only two months ago, a plan for an 1,100-ft. arch-truss span was put on a definite basis, a specially noteworthy project because shorter spans would have served, but the longer one proved the better. In England, a companion structure to the Forth bridge is under way. Thus, quite generally in the world, bridge construction is attaining a scale of magnitude that but few years back seemed quite beyond the range of the practicable or at least the desirable.

That this fact reflects the study and great advance of recent decades in the art of bridge construction is obvious, but is perhaps only of secondary importance. Most significant is the extensive, world-wide rise of the demand for bridges over large waterways that is manifested by the great bridge enterprises. In this respect, the present era or the era just beginning is sharply marked off from the 50 or 75 years of bridge construction that have just gone by. And this differentiation, moreover, constitutes fair assurance that the movement now begun will continue for many years to come.

Intercommunication needs have grown almost critically within the last quarter century. One great factor, of course, was the new place acquired by the highway, because of the creation of motor vehicles, but in all probability it is not the only one. The intensification of modern life, increasing visibly for several decades, was slow to express itself in a demand for readier communication, and when such expression was about to begin it was restrained for a dozen years by the war, together with its forerunners and its sequelæ. We are now witnessing the summed effect of forces that have long been accumulating.

Fortunately the technical arts are well equipped for the demands to be made upon them in bridge construction. Engineering skill in the field of bridges stands on a level of peculiar excellence, in both its scientific and its practical development. Moreover, it is in such temper as to be prepared for further development when increasing demands call for them. Its resources are sure to prove sufficient for all that may be asked of it.

What is to come in future may be forecast through a survey of communication needs and the extent to which large bridges now planned or under construction will satisfy them. Present enterprises, it will be seen, provide for only a few key points of traffic connection. Great lengths of rivers remain to be bridged, and safe to say they will be bridged, unless the present importance of the highway proves ephemeral or exaggerated. Financial resources to accomplish the task will not be lacking, it may be judged, for at the present time much activity is being devoted to the problems of this phase of the matter; new financing methods are being developed actively, and the outlook is that it will prove possible to find the money as promptly as the demand comes into tangible being. There is continued growth also in the degree of concentration of human activities, and this growth inevitably carries with it an increasing economic and temperamental demand for better intercommunication facilities. The great enterprises of the moment are not individual and exceptional projects, but are in truth the first evidences of a new era of large-scale bridge construction.

Railroad Consolidation Not Dead Issue

THAT railroad consolidation is not a dead issue is clearly indicated by the spectacular trading in Wheeling & Lake Erie R.R. stock on the New York Stock Exchange during the past week, followed by the announcement that control of that railroad had been bought jointly by the New York Central, the Nickel Plate, and the Baltimore & Ohio. Behind the official announcement is the interesting fact that three powerful railroad companies have been willing to spend good money for a heretofore unproductive railroad because that railroad was needed by an additional trunk system in process of building. Alone, the W. & L. E. was simply a poor coal road, but coupled with the Western Maryland by way of the Pittsburgh & West Virginia, it forms a link between the Great Lakes and tidewater at Baltimore whose importance could not be overlooked by the other trunk systems.

This is but one of the recent developments. Two others are less spectacular but of more importance. On Friday, the Chesapeake & Ohio asked the Interstate Commerce Commission for authority to acquire control of the Pere Marquette and the Erie. This proposal is the latest move of the Van Sweringen brothers towards the formation of another trunk system in the East. Last year the commission would not approve their plans to build up a system around the Nickel Plate because some of the financial features were faulty, chiefly in respect to the interests of the Chesapeake & Ohio stockholders. Now, under the new proposal, the Chesapeake & Ohio is to be used as the main stem of the system.

In the West, the Northern Pacific and the Great Northern are planning a unification which will include the Spokane, Portland & Seattle Ry. and will be closely allied with the Chicago, Burlington & Quincy R.R. through stock ownership.

Thus, the slow process of railroad consolidation is working itself out, not through enforced combinations but by natural development under the watchful eye of the Interstate Commerce Commission. The fact that the consolidations anticipated by the amended Interstate Commerce Act are practically impossible of accomplishment has not, as many thought it would, put an end to the formation of new systems. Instead, the groupings are being worked out by the railroads themselves in reaching out for new territory and improving their traffic arrangements.

Arkansas Road Reform

FINANCING of highway construction in Arkansas has, after a tempestous decade, attained something of reason. By the terms of an act signed by the governor of Arkansas early this month the state assumes all financial obligations of the road-improvement districts and a financial plan has been designated to fund the estimated $50,000,000 of outstanding road district bonds. Details of this plan are given on p. 294.

Arkansas has presented, in clear fashion, the dangers attending an attempt to secure an interconnected system of state roads through numberless independent road-building organizations. Confronted, as the state was more than a decade ago, with the necessity for keeping abreast of a widespread road-improvement program, Arkansas was hedged, financially, by a constitutional restriction against bond issues for public improvements —a relic of carpet-bag days. State legislative measures created the road-improvement district which bonded itself, engaged its own engineers, and built its little strip of road with little or no thought of maintenance. Some of the highways thus constructed presented spotty mileages of varying section and surface. Heavy financial obligations were assumed in the fever to get better highways — obligations that mythically balanced the added values accruing from highway improvement. At the peak of the excitement more than 450 improvement districts had been formed and over $100,000,000 in bonds authorized or issued. True, a number of the districts died before they began to function, but enough of them lived to arouse a suspicion that the counties are the preferable legislative units to make and maintain roads.

When, in 1921 the U. S. Supreme Court declared the law creating many of the districts unconstitutional, the state legislature began to see that the only way out was a unified state highway organization with full powers to design, construct and maintain a designated system. Further argument was given it in the temporary withdrawal of federal aid in 1923. Since then the state highway department has been functioning as such an organization should. Its engineers have been striving to save a patched-up mileage with judicious maintenance and some little construction. Dissatisfaction still spread its rumors, for road-improvements bonds were still outstanding and the roads themselves had deteriorated. But now, with the assumption, on the part of the state, of $50,000,000 of these bonds, and sound financing arranged for their retirement, it is obvious that the state highway commission's worth has been established. The vicious road-improvement district as a predominant system has been laid in its proper grave.

Large Theater Balcony Carried by Heavy Truss Framing

Balcony of Roxy Theater in New York City Seats 2,110—Main Truss Built with Three Chords—Diagonal Theater Layout—Four Main Supporting Columns

By A. T. North
American Institute of Steel Construction, New York

RECENT years have brought a great evolution in theater construction. Increase in seating capacity is the most important, but almost equally significant in their structural aspects are the elimination of the visible columns that supported the balcony and gallery; improved visibility, heating, ventilation, sanitation, and illumination; increased safety to the public because of a better fire-resisting construction and better means of ingress and egress.

The problem of securing the larger seating capacities and at the same time unobstructed view of the stage from all seats is the principal problem that confronts the structural engineer. The inclosing of the roof, while important, is usually done without any irksome limitations and is a matter of normal engineering design. But the construction of a balcony with a capacity of over 2,000 seats having no visible columns to support it and of such a shape and contour that it conforms to the architectural requirements of beauty and visibility is a very special problem.

Turning from the old-time theater, with from 900 to 1,000 seats, balcony and gallery floors made of wooden joists cantilevered over wooden girders supported by wooden or cast-iron columns, to the balcony of the new Roxy Theater in New York City with a seating capacity of 2,110 persons causes one to realize the great improvement in theater construction. The capacity of this theater is about 6,000 seats, divided approximately as follows:

Lower floor	2,660 seats
Mezzanine	1,034 seats
Balcony	2,110 seats
Orchestra pit	110 seats
Total	6,104 seats

The balcony seats 34.5 per cent of the total and would carry the total population of hundreds of small towns.

The shape of the auditorium has been changed to make possible the large areas needed in these balconies. In the motion picture theater it is of course essential

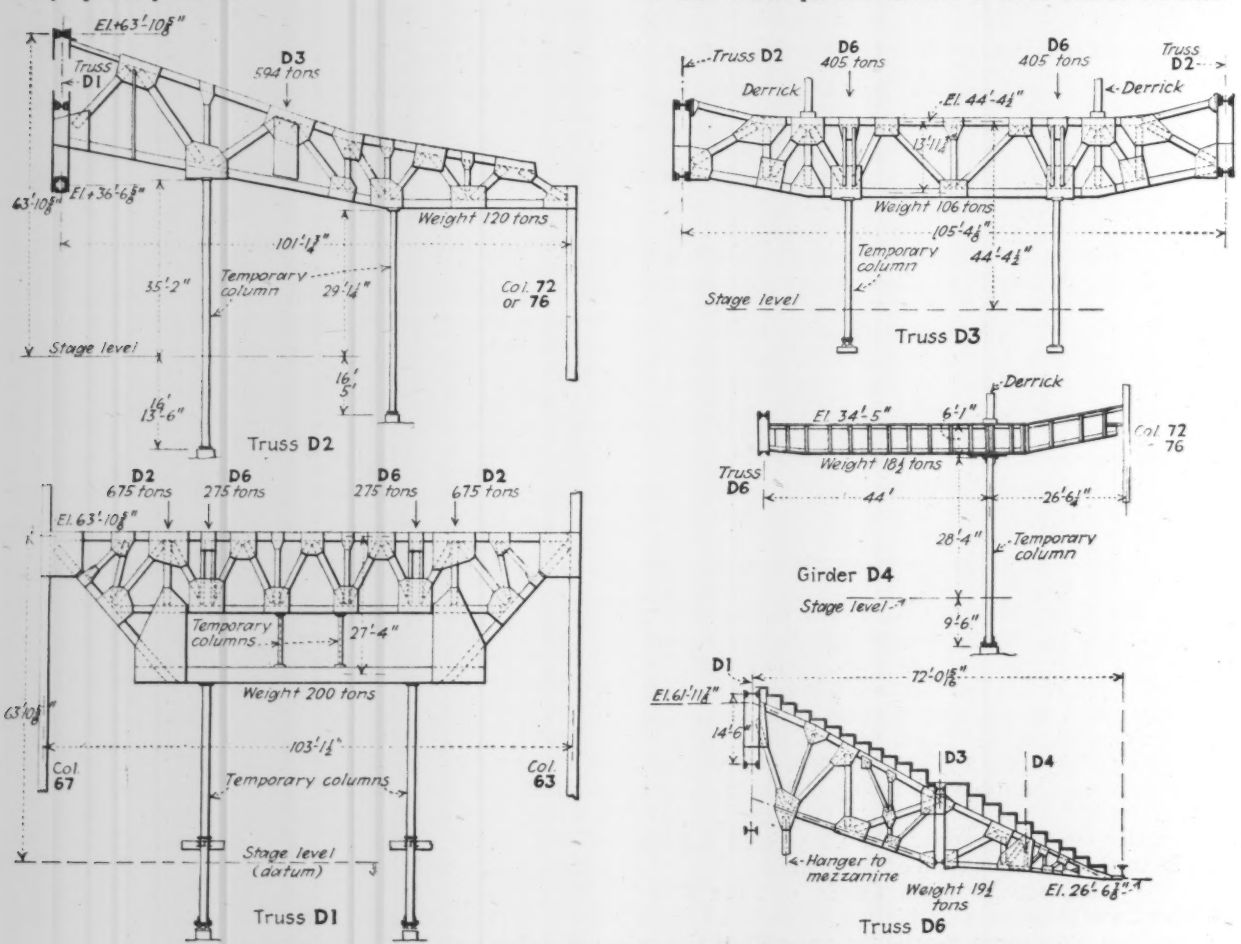


FIG. 1—TRUSSES AND GIRDERS OF MAIN BALCONY FRAMING, ROXY THEATER

that all of the seats be within the limits of clear vision and this requirement influences the plan and dimensions. The Roxy Theater has its stage in one corner of an approximately square auditorium. This arrangement permits an unusually long range of balcony seats.

The two columns which support the rear of the balcony are 103 ft. apart. The two columns which support the front are about 169 ft. apart; the line connecting them is the chord of an arc of about 190 ft., which is the length of the longest row of balcony seats. These

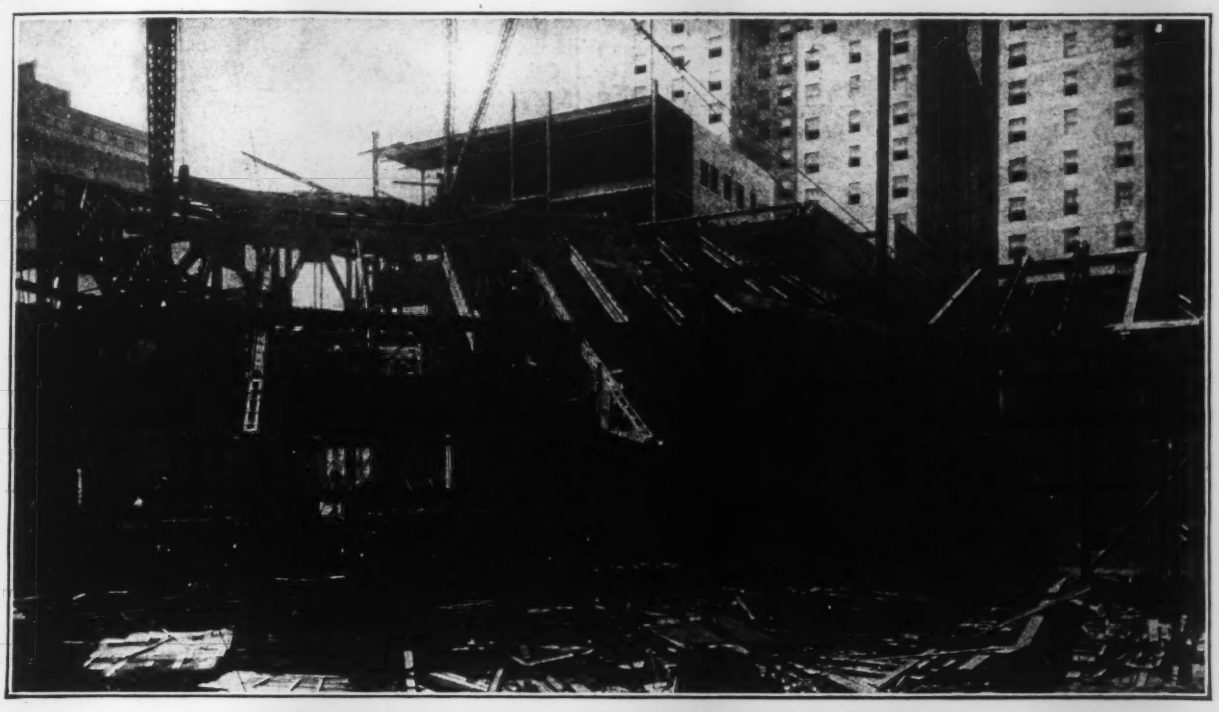


FIG. 2—BALCONY TRUSSES OF ROXY THEATER SEEN FROM STAGE
Truss D3 and cantilever trusses in foreground. Truss D2 at right. Temporary columns still in place.

One of the essential requirements was that there were to be no columns within the seating area. The entire balcony, tunnel floor and mezzanine floor are supported on four columns concealed in the enclosing walls. Both tunnel floor and mezzanine floor are hung from the balcony framing by means of six hangers.

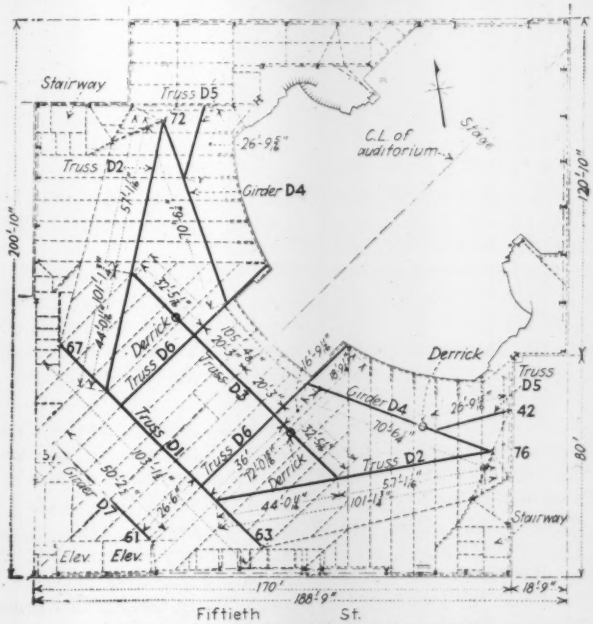


FIG. 3—FRAMING PLAN OF BALCONY

four columns support a framing system of ten principal members—trusses and girders—which carry the floor system of the balcony.

Trusses D1 and trusses D2 (see framing plan, Fig. 3) are the principal elements of the system, being carried directly by the columns and in turn supporting the other members of the system. Truss D1, the primary truss, is 103 ft. long between columns 63 and 67, is about 30 ft. high and weighs 200 tons. It is believed to be the largest truss that has ever been installed in a structure of this kind. As seen from its elevation, sketched in Fig. 1, this truss is unusual, and presented some difficult problems. It extends through two stories, but the architect demanded that a passageway 47x10 ft. be maintained through the lower half of the truss at the tunnel floor level. Because of this passageway the web members of the truss could not be continued to the bottom chord, and it became necessary to insert a middle chord. Under symmetrical loading the stresses would have been easily determined, but as unsymmetrical live-load also had to be considered the design was difficult and tedious. Detailing presented further problems, as instanced by the fact that the main gusset plates are 12x18 ft. in size. Over 5,000 field rivets had to be driven in this truss alone.

In erecting this truss, temporary columns were used, as indicated in Fig. 2. Two temporary columns were set at 40-ft. spacing to support the lower chord of the truss, and again on top of the lower chord were set two short temporary columns on which, in turn, was laid the middle chord. After the truss was completely as-

sembled these four columns were removed and the entire load taken by columns 63 and 67.

Truss D2, of which there is one on either side, is 100 ft. long between its supports, on truss D1 and column 72 or 76, has an average height of about 15 ft. and a weight of 120 tons. This truss is irregular in shape, to conform to the profile of the balcony section. About midway of its length it supports one end of truss D3. It also was erected on two temporary columns. Truss D3, which spans between trusses D2, is about 105 ft. long and is 16 ft. high, and weighs 106 tons. In addition to supporting practically the entire load of trusses D6, it carries its portion of the floor system loads. The temporary erection columns for supporting the truss until assembled were in this case also used to take the load of the erection derricks, amounting to a maximum of 100 tons each. This did not require any special provision in the proportioning of the truss.

Girders D4, which carry the side wings of the balcony, span about 70 ft. from truss D6 to columns 72 or 76. Each is a plate girder about 6 ft. deep, weighing 18½ tons. To conform to the balcony floor profile the

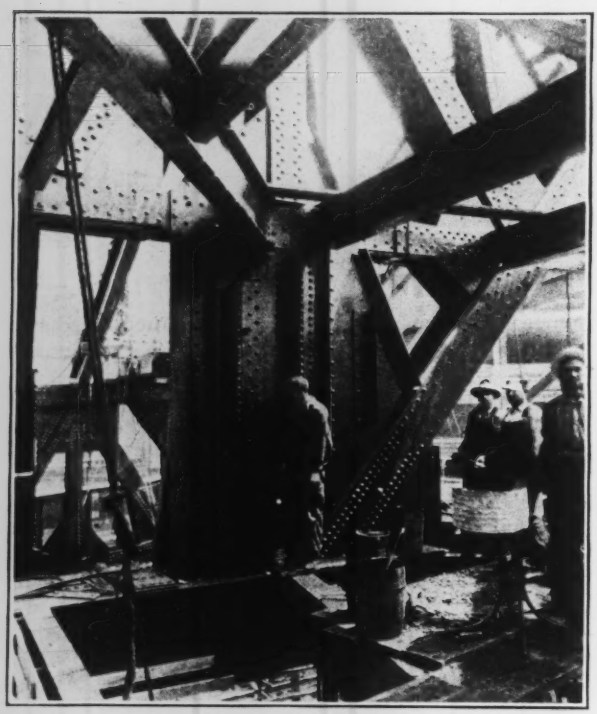


FIG. 4—HEAVY GUSSET PLATE OF TRUSS D1

girder profile is bent vertically, with a difference of elevation of about 3 ft. 9 in. One of the two girders, D4, had a temporary supporting column near the center, to take the load of a 100-ton erection derrick resting on its upper flange.

The cantilever trusses D6 are supported by trusses D1 and D3. Each is 72 ft. long, half its length cantilevering beyond truss D3. Midway in the cantilevered portion is imposed the load from girder D4. The difference in elevation of its two ends is about 38 ft., which illustrates the flexibility of steel construction and its ability to adjust itself to extraordinary requirements within restricted limits.

There are two main roof trusses which support seven intermediate roof trusses. One of these roof trusses is 156 ft. 9 in. long and weighs about 100 tons. These

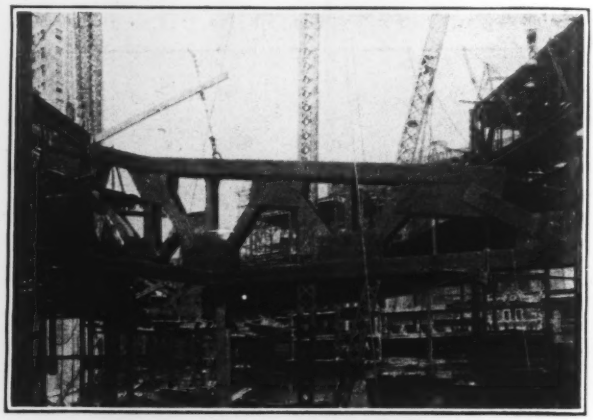


FIG. 5—TRUSS D2 UNDER ERECTION
Truss D3 and girder D4 behind.

trusses had to be erected by derricks which were set on the balcony.

The Roxy Theater was designed by Walter W. Ahlschlager, architect. The balcony construction was originally designed for reinforced concrete, but when checked for conformity with the New York building code it was found to be impracticable. The use of steel was then adopted and the design and details were made under the direction of Otto F. Sieder, chief engineer of Levering & Garrigues Co., who fabricated and erected the work.

The element of time was one of the most important factors in the construction of the steelwork. The building had to be designed, shop drawings prepared, the steel fabricated and erected within a period of seven months. Despite the many revisions which had to be made in the original design and the many difficult problems which were encountered in the design and erection of a structure of this kind, the erection of the steelwork was completed on time.

Thirty Million Spent on St. Lawrence River

Money expended by the Canadian Government in the up-keep of the St. Lawrence river up to the end of 1926, totals $30,500,000, according to a statement by the deputy minister of marine and fisheries. This amount was divided as follows:

Quebec to the sea, from 1535 until the end of 1926—$4,752,673; Montreal to Quebec, between 1851 and 1888, and expended by the Montreal Harbor Commissioners in the improvement of the channel, but subsequently assumed by the Dominion Government—$3,402,494; Montreal to Quebec, 1888 to 1903-04, expended by the department of Public Works in deepening and widening the channel—$3,891,113; Montreal to Quebec, 1903-04 to 1926, expended by the department of Marine and Fisheries in deepening and widening the channel—$18,603,895. The deputy minister further stated that the above figures do not include large sums expended by the Dominion Government to provide aids to navigation and for ice-breaking operations in the St. Lawrence channel between Montreal and the sea.

Studies of Wood Preservation and Treatment

Methods of Applying Oils and Salt Solutions—New Preservatives Suggested—Pressure and Open Immersion Processes

PRESERVATIVE materials and treatments, possibilities of new developments, together with economic aspects of plant operation, were among the main features of papers and reports presented at the annual meeting of the American Wood Preservers Association at Nashville, Tenn., in January. Abstracts given below present the main points of general interest to engineers.

Penetration of Preservatives—Experiments on the relation of pressure, temperature and viscosity of creosote to its penetration and absorption have been made by J. D. MacLean, U. S. Forest Products Laboratory, supplementing similar experiments with zinc-chloride and creosote-petroleum mixtures. The viscosity of the creosote, varying with temperature, was the most important factor. Increasing the temperature not only increased the penetration and absorption at each pressure used, but also made increases in pressure much more effective. The relation of temperature, pressure and penetration can be expressed by an empirical equation. Experiments to show the effect of temperature alone on penetration and absorption indicate that while temperature is a factor affecting the results to some extent it is of only minor importance in comparison with absolute viscosity. Probably much of the effect of temperature aside from the effect on viscosity, is due to the fact that the higher temperatures heat the wood more rapidly during a given treating period, thereby producing conditions that favor treatment.

Permanence of Preservatives—Most of the requirements of a wood preservative are susceptible to test, but the important problem of its permanence remains to be solved and tests in this direction, outlined by E. Bateman, U. S. Forest Products Laboratory, aim at determining the movement of the preservative within the wood and determining whether loss is due to evaporation or heating. The indications are that permanence of the preservative is bound up inseparably with the movement of liquids through the wood.

Use of Inorganic Salts—A comparison of the toxicity of various inorganic salts as wood preservatives, submitted by E. Bateman and R. Baechler, of the U. S. Forest Products Laboratory, shows that some of these attack steel and could not be used in pressure treating equipment, although copper and nickel salts might be valuable for open-tank treatment. In addition to zinc chloride and sodium fluoride, which are already well known, there are borax and sodium chromate, both of which warrant a trial on railroad ties, either with or without a subsequent treatment with fuel oil. Further investigation should be made also as to the value of iron sulphate.

Steam Treatment—A committee report referred to Canadian tests in which the absorption and penetration of preservative were about the same in steamed and unsteamed ties, while the former method involved a longer total time of treatment. However, it is thought possible that the 3-hour steaming period was not long enough to heat the timber sufficiently to accomplish much reduction in moisture or to aid materially in making the wood more receptive to treatment. Alternate steam and vacuum seasoning was more effective than continuous steaming and final vacuum in reducing the moisture content. This reduction by steaming was greatest in specimens having the highest moisture content, and was very slight where the moisture was as low as 30 to 40 per cent.

Non-Pressure Treatment of Poles—A superficial treatment by short-time hot immersion (not less than 15 minutes) is considered by a committee to be worth its cost and to meet a substantial demand, although the more thorough methods of at least four hours hot immersion followed by two hours cold immersion produce greater economy. Specifications for both these processes were submitted.

Treated Fence Posts—Of 7,590,000 posts treated during 1921 to 1925, inclusive, the majority were disposed of through lumber yards, while 1,777,894 were used by railways and 239,400 by state highway commissions. But of 685,592,000 wood posts in use, only 1 per cent are treated. The committee was unable to secure information as to steel and concrete posts in service, but stated that the increasing demand for treated wood posts is significant in view of the advertising campaign of substitutes for wood posts.

Car Lumber and Signal Work—In the treatment of car lumber there has been little development. Few railways are equipped to use the pressure process for lumber for repair or rebuilding, but proper use of brush treatment should greatly prolong the life of the wood. The committee recommends a standard method of preparation and application. For the trunking and capping used in railway signal work, a committee submitted a specification for pressure treatment by the empty-cell process, slightly different from the ordinary specification for treating lumber. Dryness after treatment is an essential and therefore only distillate creosote should be used, solutions or mixtures being inadvisable. To further insure a dry surface, the final vocuum should be followed by a steam bath which washes the surface and makes it unnecessary to store the timber for a long period in order to dry it.

Treatment of Fir Lumber—This committee submitted specifications for the treatment of Douglas fir lumber with creosote, but expressed the opinion that it is not yet time to report on treatment with creosote-petroleum mixtures or creosote and coal-tar solutions, as practice varies in the use of such preservatives. It recommended an investigation of treatment with zinc chloride.

Handling Materials—In handling ties at treating plants, hand labor on piecework basis is the favored method. Locomotive cranes are most economical for the heavier materials and for loading treated ties into open cars, but the committee considers that these cranes should have a higher speed of travel than is usually provided, and should be equipped with electric lights for emergency work. Much rehandling at treating plants is involved in the separation of different woods, but there is no uniformity in such separation and the A.R.E.A. specifications are not adhered to in this respect. Separation should be made before shipment to reduce rehandling at the plant. Two recommendations are: (1) the study of means to reduce personal accidents at treating plants, and (2) the offer of an annual premium for suggestions of improvements in present methods of handling materials at these plants.

Notes on Australian Railways

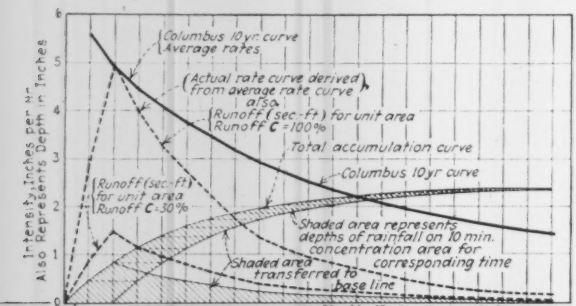
On the four railways owned and operated by the Commonwealth of Australia aggregating 1,733 miles as distinguished from those of the several states, gage difficulties are being eliminated on a 100-mile stretch by using three-rail mixed gage and doing away with one change of trains on the east-west transcontinental line. Water supply on the Trans-Australian Ry. is a trouble owing to the extreme hardness, causing scale and corrosion of the locomotive boilers, while experiments in water treatment have not been encouraging. Surveys are in progress for the extension of lines which eventually will form a north-and-south transcontinental railway of 3-ft. 6-in. gage, but proposals for the construction of a 160-mile extension on this line were so high that the Commonwealth government decided to have the work done by its railway department. With 86 miles of extensions opened during the year ending June 30, 1926, the railway system of New South Wales, Australia, aggregates 5,742 miles, besides 318 miles under construction, according to the annual report of the Railway Commissioners. Operating expenses absorbed 73.91 per cent of the earnings, and on a number of lines the earnings were insufficient to meet operating expenses and interest. Rail-motor cars are used on several branch lines. At Sydney, work is progressing on the electric rapid-transit subway and on the electrification of the suburban lines. Two large power houses have begun supplying current to the city and the street railways.

Rainfall-Runoff Analysis in Storm-Sewer Design

A Study Based on the Rational Method Using the Ten-Year Rainfall Intensity Curve of Columbus, Ohio

By John A. Rousculp
Assistant Sewer Engineer, City of Columbus, Ohio

In the use of the rational method in storm-sewer design it is assumed that the maximum rate of runoff will be produced by a rain of uniform intensity, distributed over the drainage area in question, and having the same duration as the time of concentration. This study, which for convenience is based on the ten-year rainfall intensity curve for Columbus, Ohio, is intended to show graphically whether or not this assumption does give the correct theoretical maximum rate of runoff.


Columbus 10 yr. curve
Average rates
(Actual rate curve derived from average rate curve also)
Runoff (sec.-ft.) for unit area
Runoff C=100%
Total accumulation curve
Columbus 10 yr. curve
Runoff (sec.-ft.) for unit area
Runoff C=30%
Shaded area represents depths of rainfall on 10 min. concentration area for corresponding time
Shaded area transferred to base line
Intensity, Inches per Hr. Also Represents Depth in Inches

	Time, Minutes	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
2	Rate, in per hr	5.60	4.90	4.45	4.07	3.73	3.44	3.16	2.90	2.70	2.50	2.35	2.20	2.07	1.95	1.85	1.75	1.65	1.57	1.50	1.43
3	Equiv. to accumulation	0.466	0.816	1.112	1.355	1.552	1.720	1.843	1.933	2.023	2.082	2.156	2.200	2.242	2.278	2.315	2.335	2.338	2.340	2.370	2.380
4	Acc. each 5 min., inches	0.466	0.350	0.296	0.243	0.197	0.168	0.123	0.090	0.090	0.059	0.074	0.044	0.042	0.036	0.037	0.020	0.003	0.002	0.030	0.010
5	Acc. on 10 min. area, inches	0.466	0.82	0.66	0.54	0.45	0.37	0.29	0.220	0.19	0.16	0.14	0.12	0.10	0.08	0.095	0.050	0.042	0.035	0.032	0.03
6	Runoff, Sec.-Ft. for unit area	2.82	4.95	3.98	3.26	2.72	2.24	1.76	1.33	1.15	0.96	0.84	0.72	0.605	0.482	0.392	0.302	0.254	0.211	0.193	0.181
7	Runoff, Sec.-Ft. Unit A C=30%	0.846	1.485	1.194	0.978	0.816	0.672	0.528	0.399	0.345	0.288	0.252	0.216	0.181	0.144	0.117	0.090	0.076	0.063	0.580	0.054

FIG. 1—RAINFALL-RUNOFF ANALYSIS, COLUMBUS, OHIO, BASED ON THE RATIONAL METHOD

Total accumulation curve values are computed from Line 2 values.

Line 4 is composed of differences between adjacent entries in Line 3.

Line 5 is computed by adding adjacent entries in Line 4 by twos to give the 10-min. value, on the assumption that the runoff from any 10-min. area, assuming a uniform runoff coefficient, will at any time be proportional to the corresponding accumulated depth in Line 5.

The curve on the lower boundary of the upper shaded areas in the diagram is drawn through points established by transferring points on the total accumulation curve, ten minutes to the right. The depths shown by this shaded area represent the values given in Line 5. The lower shaded area represents the values in Line 5 plotted on the base line.

Line 6: Since it is assumed that the runoff at any time from a ten-minute area is proportional to the corresponding ten-minute accumulated depth, we may compute a coefficient for unit area and 100 per cent runoff coefficient as follows:

$$\frac{1a \times 43{,}560 \times 1 \text{ in.}}{10 \times 60 \times 12} = 6.05 \text{ sec.-ft.}$$

Multiplying values in Line 5 by this coefficient (6.05) we get Line 6 values, from which the runoff curve for unit area is (runoff coefficient = 100 per cent) plotted. This curve also represents the approximate actual rate of rainfall in inches per hour.

Line 7 values are computed by multiplying Line 6 values by 30 per cent. These values plotted as a curve represent the runoff in second-feet per acre (runoff coefficient = 30 per cent) at any time during the storm. This curve is used in working out the sample problem given in the text.

Fig. 1 shows this curve and also other curves derived from it, as explained in the notes to the tabular values given below the diagrams.

Sample Problem—The Whittier St. district of Columbus, Ohio, will be used as a sample problem. The area is 485 acres. Measuring the areas at various points of inlet and computing the time in the various branches of the system, the areas were found to concentrate as shown in columns 1 and 2 of Table I. Before applying the runoff curve in Fig. 1 to the areas in Table I the following assumptions made in preparing Fig. 1 will be stated: (1) Ten-minute inlet time. (2) Uniform runoff coefficient of 30 per cent. (3) That the runoff from any initial area will vary as the actual rate of rainfall, as explained in Fig. 1. (4) That the ten-year rainfall curve may be considered as representing a single storm.

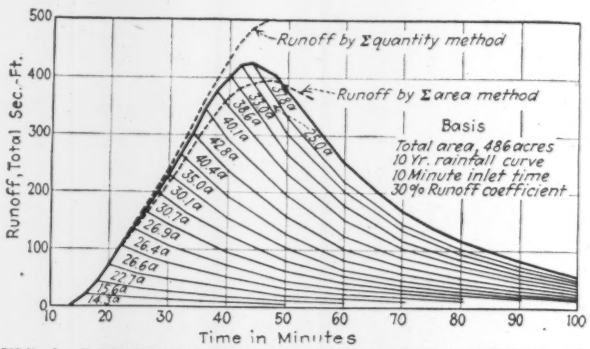


FIG. 2—RAINFALL-RUNOFF ANALYSIS FOR WHITTIER ST. SEWER DISTRICT, COLUMBUS, OHIO

Applying the runoff curve in Fig. 1 to areas in Table I we get the results given in Table II, which are plotted in Fig. 2. The different areas are separated by a two-minute time interval in agreement with Table I. The intended meaning of Fig. 2 is that if the ten-year storm should occur on the area used above, with a uniform runoff coefficient of 30 per cent, and assuming all drains to be of sufficient capacity, the runoff, in second-feet, at the point of outlet would be in accordance with Fig. 2, the time starting with the beginning of the storm.

The runoff from the Whittier St. district is also computed by two other methods of applying the rational formula, the results being given in Table I. Of these two methods the one most generally used is called the summation area (ΣA) method. The other is called the summation quantity (ΣQ) method. The runoff computed by these methods is plotted in Fig. 2.

To study the results given by greater areas and longer time the runoff curves on Fig. 2 are replotted on Fig. 3 first (as they stood originally) and then in the stem and three-prong form shown in solid lines. In the third of these forms the second area is shown as starting to

TABLE I—DISTRIBUTION OF AREAS—WHITTIER ST. SYSTEM —AND COMPUTED RUNOFF BY ΣQ AND ΣA METHODS.

1	2	3	4	5	Column 6 = (2×4×5)	7	Column 8 = (3×4×5)
Time From Outlet	Area Tributary In Each 2M (Acres)	ΣArea or Accumulated Area	Rate 10-Yr. Curve Start with 10M.	Runoff C=30% Quantity	Total Q or ΣQ		Quantity by ΣArea
4	4.6	4.6	4.90	0.3	6.7		6.7
6	9.7	14.3	4.70	0.3	13.7		20.4
8	15.6	29.9	4.52	0.3	21.2		41.6
10	22.7	52.6	4.38	0.3	29.8		71.4
12	26.6	79.2	4.20	0.3	33.5		104.9
14	26.4	105.6	4.07	0.3	32.2		137.1
16	26.9	132.5	3.93	0.3	31.6		168.7
18	30.7	163.2	3.79	0.3	34.8		203.5
20	30.1	193.3	3.67	0.3	33.1		236.6
22	35.0	228.3	3.55	0.3	37.2		273.8
24	40.4	268.7	3.44	0.3	41.5		315.3
26	42.8	311.5	3.32	0.3	42.6		357.9
28	40.1	351.6	3.21	0.3	38.6		396.5
30	38.6	390.2	3.10	0.3	35.9		432.4
32	33.0	423.2	3.00	0.3	29.7		462.1
34	25.0	448.2	2.90	0.3	21.7		483.8
36	17.4	465.6	2.82	0.3	14.7		498.5
38	10.8	476.4	2.74	0.3	8.5		507.0
40	5.8	482.2	2.66	0.3	4.6		511.6
42	2.6	484.8	2.58	0.3	2.0		513.6
44	1.2	486.0	2.50	0.3	.9		514.5

Values from this table are plotted on Diagram 2.

TABLE II—RAINFALL-RUNOFF ANALYSIS RATES APPLIED TO WHITTIER ST. SYSTEM CONCENTRATING AREAS.

Runoff Time From Outlet	Time — Sec.-Ft./A. Area Tributary In Each 2 Min.	10	15	20	25	30	35	40	50	60	70	80	90	100
		RUNOFF FROM AREA AT TIME (SECOND-FEET)												
		1.485	1.194	0.978	0.816	0.672	0.528	0.399	0.288	0.216	0.144	0.090	0.063	0.054
4	4.6	6.8	5.5	4.5	3.7	3.1	2.4	1.8	1.3	1.0	0.7	0.4	0.3	0.3
6	9.7	14.4	11.6	9.5	8.0	6.5	5.1	3.9	2.8	2.1	1.4	0.9	0.6	0.5
8	15.6	24.6	18.6	15.2	12.7	10.5	8.2	6.6	4.5	3.4	2.3	1.4	1.0	0.8
10	22.7	33.6	27.1	22.2	18.5	15.3	12.0	9.1	6.5	4.9	3.3	2.0	1.4	1.2
12	26.6	39.5	31.8	26.0	21.7	18.0	14.1	10.6	7.7	5.7	3.8	2.4	1.7	1.4
14	26.4	39.1	31.6	25.8	21.5	17.8	13.9	10.5	7.6	5.7	3.8	2.4	1.7	1.4
16	26.9	39.8	32.0	26.3	21.9	18.1	14.2	10.7	7.7	5.8	3.9	2.4	1.7	1.4
18	30.7	45.5	36.7	30.0	25.0	20.7	16.2	12.3	8.8	6.6	4.4	2.8	1.9	1.6
20	30.1	44.6	36.0	29.5	24.5	20.4	16.9	12.0	8.7	6.5	4.3	2.7	1.9	1.6
22	35.0	52.0	41.8	34.2	28.5	23.5	18.5	14.0	10.1	7.6	5.0	3.1	2.2	1.9
24	40.4	60.0	48.3	39.5	32.9	27.2	21.3	16.1	11.6	8.8	5.8	3.6	2.5	2.2
26	42.8	63.4	51.1	41.9	34.8	28.8	22.6	17.1	12.3	9.3	6.2	3.9	2.7	2.4
28	40.1	59.5	48.0	39.3	32.7	27.0	21.2	16.0	11.5	8.7	5.8	3.6	2.5	2.2
30	38.6	57.3	46.1	37.8	31.5	26.0	20.4	15.4	11.1	8.3	5.6	3.5	2.4	2.1
32	33.0	49.0	39.4	32.3	26.9	22.2	17.4	13.2	9.5	7.1	4.7	3.0	2.1	1.8
34	25.0	37.0	29.9	24.5	20.4	16.8	13.2	10.0	7.2	5.4	3.6	2.2	1.6	1.3
36	17.4	25.8	20.8	17.0	14.2	11.7	9.2	7.0	5.0	3.8	2.5	1.6	1.1	0.9
38	10.8	16.0	12.9	10.6	8.8	7.3	5.7	4.3	3.1	2.3	1.6	1.0	0.7	0.6
40	5.8	8.6	6.9	5.7	4.7	3.9	3.1	2.3	1.7	1.2	0.8	0.5	0.4	0.3
42	2.6	3.8	3.1	2.5	2.1	1.7	1.4	1.0	0.8	0.6	0.4	0.2	0.2	0.1
44	1.2	1.8	1.4	1.2	1.0	0.8	0.6	0.5	0.3	0.2	0.2	0.1	0.1	0.1

Values from this Table are plotted on Diagram 2.

TABLE III-DISTRIBUTION OF AREAS; WHITTIER ST. SYSTEM, USED THREE TIMES—AND RUNOFF BY ΣQ AND Σ A METHODS

1	2	3	4	Column 5= (2+3+4)	6	7	8	Column 9= (5×7×8)	10	Column 11= (6×7×8)
Time (Min.)	Area Each 4 Min. — 1st.	2nd.	3rd.	Combined Area—Each 4 Min.	Σ A or Accumulated Area	Rate, 10-Year Curve, Start With 10 M.	Runoff C=30%	Quantity	Σ Q or Accumulated Quantity	Quantity by Σ Area
14	4.6			4.6	4.6	4.90	0.3	6.8	6.8	6.8
18	25.3			25.3	29.9	4.52	0.3	34.3	41.1	40.5
22	44.3	Start at 44 Min.		49.3	79.2	4.20	0.3	62.0	103.1	99.7
26	53.3			53.3	132.5	3.93	0.3	62.8	165.9	156
30	60.8			60.8	193.3	3.67	0.3	67.0	232.9	213
34	75.4			75.4	268.7	3.44	0.3	77.7	310.6	277
38	82.9		Start at 64 Min.	82.9	351.6	3.21	0.3	79.7	390.3	337
42	71.6			71.6	423.2	3.00	0.3	64.5	454.8	381
46	42.4	14.3		56.7	479.9	2.82	0.3	48.0	502.8	406
50	16.6	38.3		54.9	534.8	2.66	0.3	43.8	546.6	427
54	3.8	53.0		56.8	591.6	2.50	0.3	42.5	589.1	444
58	....	57.6		57.6	649.2	2.38	0.3	41.1	630.2	463
62	....	65.1		65.1	714.3	2.46	0.3	44.1	674.3	484
66	....	83.2	14.3	97.5	811.8	2.14	0.3	62.5	736.8	520
70	....	78.7	38.3	117.0	928.8	2.04	0.3	71.5	808.3	567
74	....	58.0	53.0	111.0	1039.8	1.95	0.3	64.9	873.2	608
78	....	28.2	57.6	85.8	1125.6	1.87	0.3	48.0	921.2	630
82	....	8.4	65.1	73.5	1199.1	1.79	0.3	39.5	960.7	645
86	....	1.2	83.2	84.4	1283.5	1.71	0.3	43.3	1004.0	657
90	....	....	78.7	78.7	1362.2	1.64	0.3	38.7	1042.7	670
94	....	....	58.0	58.0	1420.2	1.58	0.3	27.5	1070.2	673
98	....	....	28.2	28.2	1448.4	1.51	0.3	12.7	1082.9	655
102	....	....	8.4	8.4	1456.8	1.45	0.3	3.6	1086.5	628
106	....	....	1.2	1.2	1458	1.40	0.3	.5	1087	612

Values from this Table are plotted on Diagram 3.

contribute 30 min. after the first area, and the third area 50 min. after the first area. The runoff diagram superimposed on itself twice, with the time interval as shown, results in a curve representing the runoff from a composite system three times as large as the initial system. Such a composite system is comparable to a system where large areas are tributary to a long intercepting sewer at points separated by rather large time intervals.

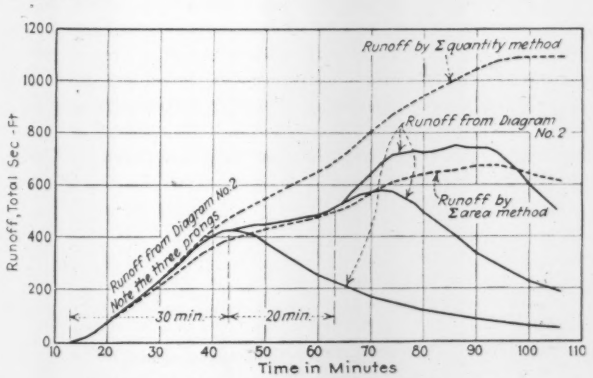


FIG. 3—ACCUMULATED RUNOFF SHOWN BY THREE METHODS

See text for explanation of the stem- and three-prong curve.

Table III shows the combination of the area with itself twice, starting the second area 30 min. after the first and the third 50 min. after the first, the same as was done on Fig. 3. To shorten the work, a four-minute time interval was used instead of two minutes as in Table I. Columns 5 and 6 of Table III give the area tributary each four minutes and accumulated areas for the composite system. The runoff from the composite area is then computed by the two methods—ΣA and ΣQ—and the results are given in Table III and plotted in Fig. 3.

Conclusion—In comparing the runoff curves by the ΣA and ΣQ methods with the analysis curve in Figs. 2 and 3 it is to be noted that the ΣA curve is a little low and the ΣQ curve is considerably high and becomes relatively higher as the time gets longer. The writer feels positive that the method of analysis advanced in this article is the basically correct analysis of the runoff problem.

The suggested method of analysis could be used with any rainfall curve or any actual storm or with any runoff coefficient, uniform or variable, with no more difficulty than is encountered in this study.

Incidentally this method of computing runoff is actually the ΣQ method used with the actual rainfall curve instead of the rainfull curve in its usual form, or average rainfall curve.

Japan Builds Superhighway from Kobe to Osaka

Four-Way Paved Highway in 110-Ft. Right-of-Way Completed, with Planned Extensions Through Terminal Cities

By H. Sakakibara
Tokio, Japan

SOME 20 miles of paved road of notable width and structure was completed in 1926 connecting the coast cities of Kobe and Osaka in Japan. Future extensions are planned into and through the terminal cities; the present account, however, refers only to the constructed road. This has been carried out as a part of the Hanshin Government Highway System and has been financed half by an Imperial Government subsidy, by debentures and by franchise for an electric railway line in the parkway between the two paved ways. Originally the plan called for a 22-ft. paved roadway and a parallel footway of rolled gravel 12 ft. wide. Then the electric railway plan developed and of several applicants franchise was granted to one on the basis that the railway should bear the cost of its own construction and the expense of widening the road to provide for the new structure. The plans were recast and are those of the road described here.

As shown by Fig. 1, the new road serves besides the terminal cities a number of cities and towns between termini. These are industrial cities and growing towns of workers called to this section by the industries. There is, therefore, a heavy present traffic and an increased traffic in prospect. The route crosses a number of streams, other highways and railways. This necessitated numerous drainage structures and in one instance involved the design of a high-level and low-level road structure. The subsoil along the road varies from yellow clay to sand, sandy loam and silt, and in places there is underlying quicksand. The lighter soils naturally offer little resistance to percolation and erosion and have a high degree of absorption. A feature of the subgrade preparation was soil stabilization with river sand, clay and a disintegrated granite all available at places along the route. Only ordinary methods and equipment were required for grading.

As is also indicated by Fig. 1 the work was divided into four sections. This was done to fit the yearly appropriations and also to permit the construction to be properly planned and supervised by the regular engineering forces. Three types of road structure were employed to suit the topographical and other conditions and they may be designated as: (1) The street or urban sections; (2) the suburban sections; and (3) the elevated section. These types of structure are shown by Figs. 2, 3 and 4. The urban sections aggregate 45,744 ft. or about 8⅔ miles and are in three separate divisions; the suburban sections aggregate 45,642 ft. or also about 8⅔ miles, and the elevated section is at the railway crossing in the city of Amagasaki.

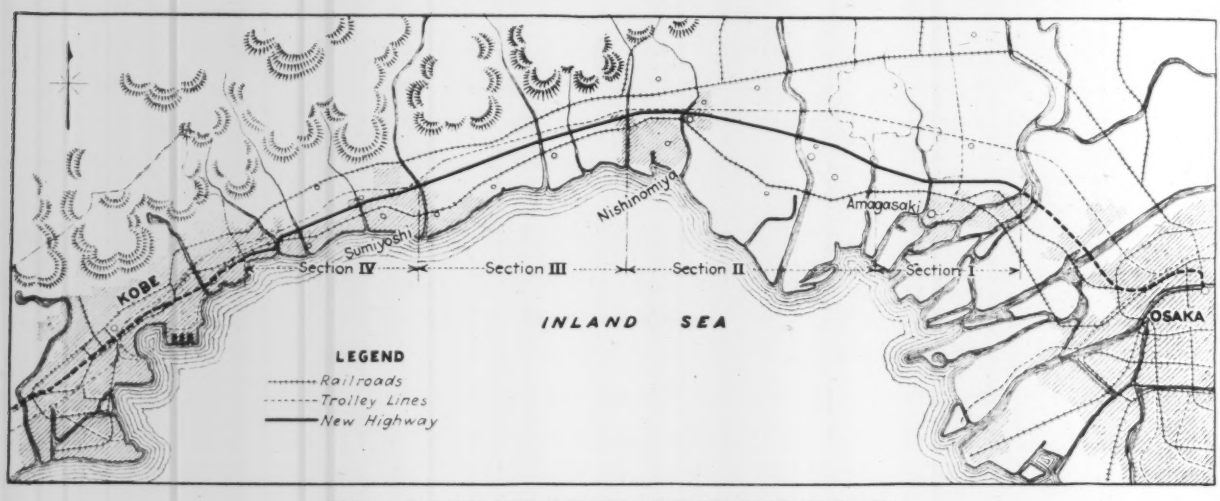


FIG. 1—JAPAN'S SUPERHIGHWAY FROM KOBE TO OSAKA

In general the street and the suburban sections are alike, consisting of a center way 19 ft. wide for two electric railway tracks and on each side a 22-ft. paved way with curbs, and finally on the outside edges two gravel footways. Outside of all are concrete gutters. The drawings give all the essential dimensions and the transverse grades. The main paved ways consist of 2 in. of bitulithic concrete on a 6-in. base of 1:3:6 cement

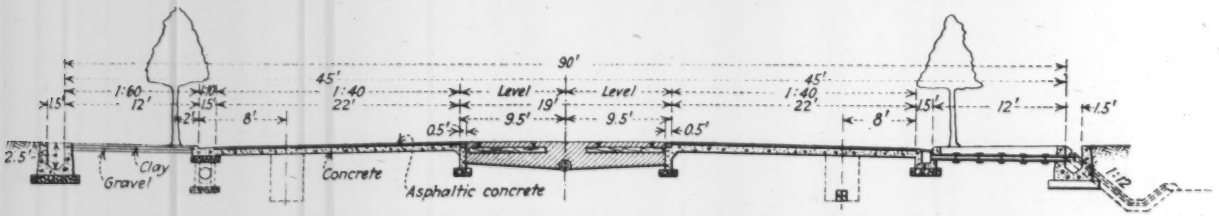


FIG. 2—SECTION OF SUPERHIGHWAY FOR CITY STREETS

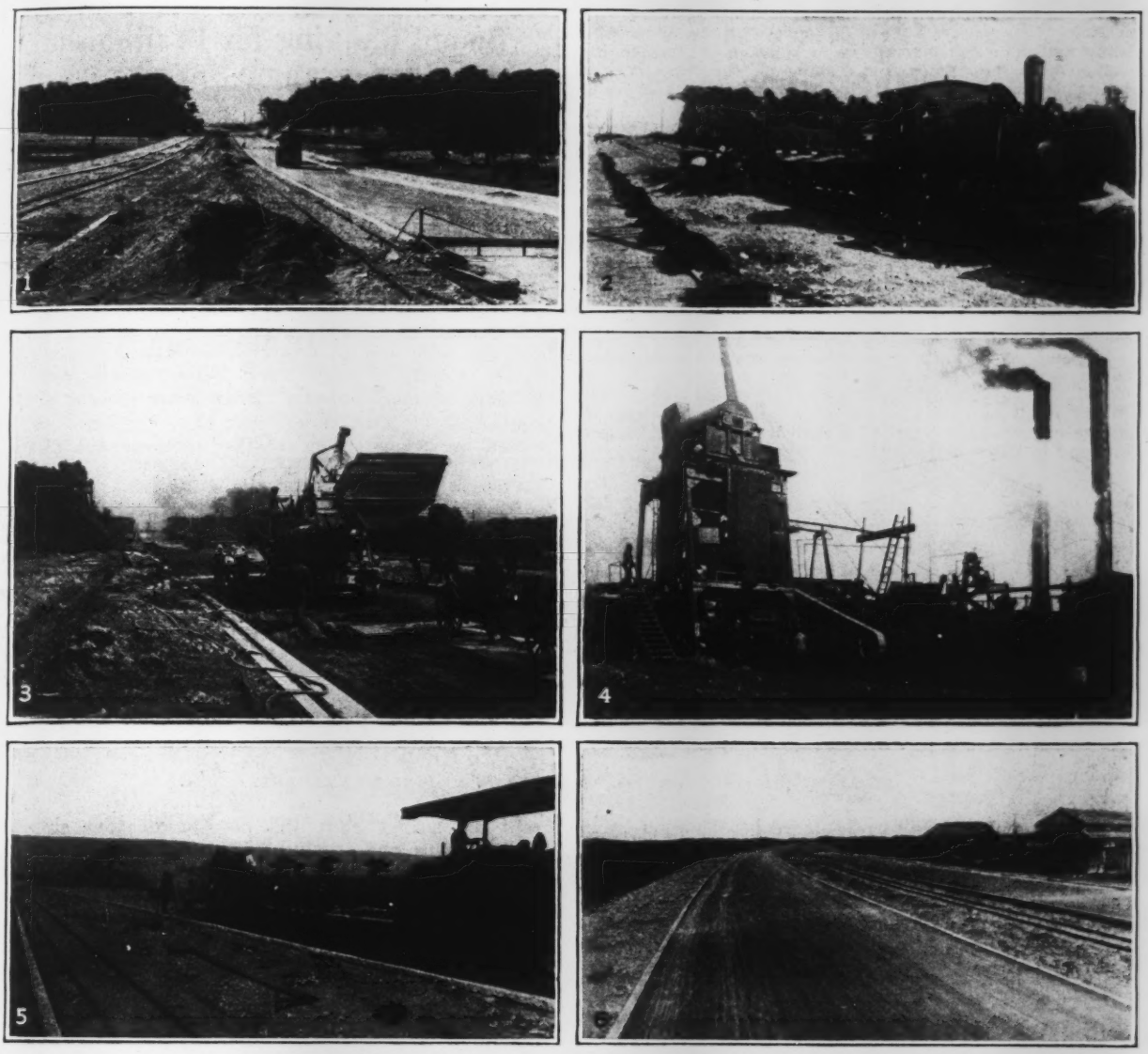


FIG. 3—CONSTRUCTION EQUIPMENT AND METHODS ON JAPAN'S SUPERHIGHWAY
(1) Rolling subgrade. (2) Hauling materials from yard. (3) Pouring concrete base. (4) Asphalt plant. (5) Placing bitulithic top. (6) Completed highway.

concrete. The noteworthy features of the design perhaps are the curbs and the drains. The latter are developed with great care as the rainfall is very heavy.

Construction was partly by force account and partly by contract. All the grading was done and virtually all of the minor structures as culverts and bridges, were constructed by government forces. The paving and surfacing were done by contract and contracts were let for the major bridges. The contractor having most of the paving was the Nippon Oil Co. Modern equipment was used throughout as shown by Fig. 3 view. For the bitulithic surfacing the following general specifications controlled:

The wearing surface shall be constructed of two dissimilar bituminous mixtures, the finer mixture to be blended and bonded with the coarser mixture at its top, so that when completed the structure will be a compact integral mass, the lower portion being rigid and stable due to a

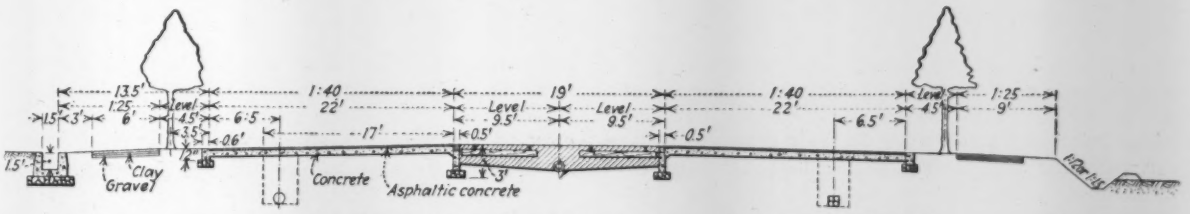


FIG. 4—SECTION OF SUPERHIGHWAY FOR SUBURBAN TERRITORY

relatively large percentage of coarse mineral particles with relatively low percentage of bitumen, the upper portion being malleable and plastic due to fine mineral matter, the change from the rigidity and stability of the lower portion to the plasticity and malleability of the upper portion being not a sudden but a gradual transition.

The coarse wearing surface mixture shall be spread upon the prepared foundation by means of hot shovels or forks, and raked to a uniform contour and to such a depth that after the fine surfacing mixture has been spread and rolled the completed wearing surface has the required thickness.

While the coarse mixture is still in a malleable condition and before it has been compacted in any manner which will prevent the essential blending and bonding of finer mixture with the coarse mixture at the top of the mass, it shall be covered with the fine mixture at the rate of 30 to 50 lb. per square yard, and more shall be added to any areas where required to cause the surface to seal or close up.

Immediately after spreading the fine mixture as described above, the pavement shall be thoroughly compressed by the use of a 10 to 12-ton three-wheel self-propelled roller. The rolling shall be continued until no roller marks appear. Places inaccessible to the roller shall be thoroughly tamped by hand to the satisfaction of the engineer.

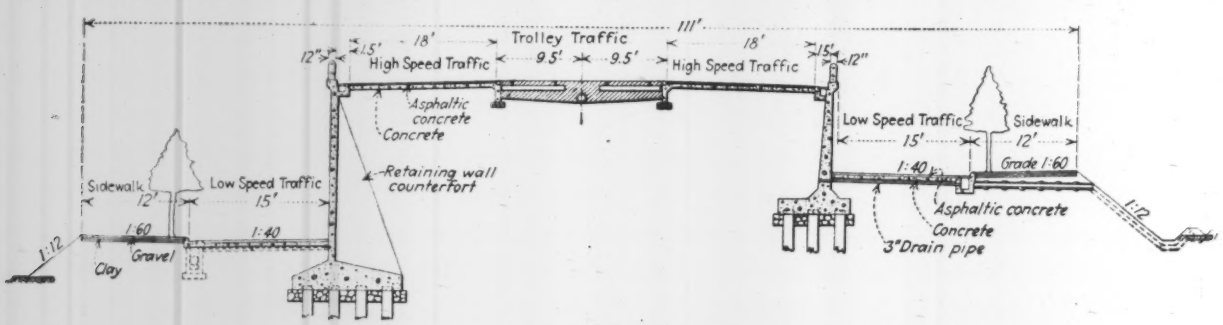


FIG. 5—SPECIAL SECTION FOR OVERHEAD CROSSING IN AMAGASAKI

Bridges and crossing are numerous. There were in all some 40 bridges and culverts and they were of all types, box, arch and girder. The crossings were usually at grade. A notable exception is the crossing in Amagasaki where the special elevated section shown by Fig. 4 was used. This carries the high-speed traffic overhead and the slow truck traffic at grade.

Staff of Pennsylvania Sanitary Water Board

The Pennsylvania Sanitary Water Board, composed of representatives of state boards, concerned in the purity of water supplies, and the attorney general, had on its payroll at the close of 1926, serving full time, a civil engineer, two chemical engineers, a chemist, an attorney and two stenographers. In addition half time service was rendered by a chief engineer, seven district engineers and seven assistant engineers, and besides this the Board has part time service without charge against its appropriation of various employees of other state departments. The Pennsylvania Sanitary Water Board has as chairman Dr. Charles H. Miner, secretary of the Health Department. Other members are the secretary of the forests and waters, the commissioner of fisheries, the chairman of the public service commission, and the attorney-general. The secretary of the board is W. L. Stevenson, chief engineer of the Department of Health. The streams of the state have been divided into classes according to their relative freedom from pollution and their possible uses as sources of water supply. The highest class (A) now has a total mileage of streams of 4,665 miles.

Sound Ranging for Position in Hydrographic Surveys

By Radio Acoustic Method Survey Ship Locates Position from Land Station 200 Miles Distant With 100-Yard Error

By W. E. Parker
Commander, U. S. Coast and Geodetic Survey, Washington, D. C.

THE principal obstacle in the way of hydrographic surveying with the same precision as has characterized good topographic surveying in recent years has been the difficulty of accurately locating the position of the surveying ship when beyond the range of visibility of shore objects. When shore objects to the number of at least three, that have been accurately located by triangulation or other methods, are visible from the survey ship, the position of that ship is readily determined graphically by measuring the angles between these objects and plotting the position with the three-arm protractor or by means of transparent paper or cloth on which the adjacent angles between the outside and the central objects have been laid off.

When such fixed objects are not visible, the hydrographer is obliged to fix the position of his ship by means of astronomic observations or by so-called "dead reckoning." The location of a ship by astronomic observations, even under the most favorable conditions, is rarely closer than from two to three miles. The precision of location by "dead reckoning" depends, of course, upon several variable quantities such as the speed of the vessel and the accuracy of the course steered; and the farther "dead reckoning" is carried from a fixed position, the greater becomes the uncertainty of the position. Ocean currents—those variable and not easily measured forces—have a profound effect on "dead reckoning" and may easily introduce errors of several miles in the estimated position of the ship.

Soundings (depth measurements) may be said to have three dimensions, namely, the vertical dimension or depth measurement and the two dimensions in the horizontal plane that fixed the position of the depth measurement. The latter two are latitude and longitude or some other similar system of rectangular co-ordinates. The depth measurement is comparatively easy to get with a high degree of accuracy, and for many years we have had no difficulty in getting soundings in any depth with considerable precision. Without knowledge of exactly where a particular sounding was

to indicate that somewhere near there is such depth.

Accordingly, the U. S. Coast and Geodetic Survey has been devoting much study to means whereby the position of the survey ship can be accurately located at any time, and as a result of this study, the radio acoustic method has been developed. The general principles underlying this method are much the same as those involved in sound ranging as practiced by artillery during the World War. In other words, the position at sea is determined by a measure of the time required for a sound wave to travel between the ship and a predetermined spot near the shore.

At at least two, and usually three, places close to the shore hydrophones are planted on the bottom at a depth of five to ten fathoms and are connected with the shore by cables. Each of these cables terminates in a suitable receiving apparatus which is connected with a radio sending station. When the hydrographer desires to fix the position of his ship he explodes a bomb of from one to four pounds of TNT under water as close to his ship as prudent and awaits results. The operation is so rapid that it is not even necessary to stop the ship as the bomb is thrown overboard and the ship proceeds on her way carrying on the survey.

The instant of explosion is recorded on a rapidly moving chronograph on the ship. This is accomplished by means of a hydrophone or similar appliance fitted into the ship's plating which picks up sound waves from the explosion, thereby so modifying the electric current flowing through the hydrophone that relays are actuated causing the chronograph pen to make a record on the tape. Meanwhile, the sound wave is advancing in all directions and is picked up at the two or three hydrophones near shore at time intervals depending upon their relative distance from the ship. These hydrophones function similarly to the hydrophone on the ship and cause radio signals to be transmitted from their several sending stations. These radio signals are also picked up in succession by the ship's radio receiving apparatus and the instant of receipt of each is recorded on the same chronograph.

We therefore get on the chronograph ribbon a record of the time of explosion of the bomb, or rather of an instant slightly later than the exact time of explosion, which interval can be determined by means which it is not necessary to go into here. Also we get records from each of the shore stations indicating the instant the sound wave reaches the hydrophone at each station. Since the velocity of the radio wave is very great (approximating that of the velocity of light) we may ignore the time for the radio wave to travel from the shore station to the ship and, for all practical purposes, assume that the time record on the chronograph is that of receipt of the subaqueous sound wave at the several shore stations. There are certain delays due to lag of relays, etc., which are appreciable but which can be measured and allowed for. We therefore have a record of the time required for the sound wave to travel to each of the shore stations, which time multiplied by the velocity of sound gives us the distance from each shore hydrophone. If the positions of the several hydrophones have been accurately determined trigonometrically, it is a simple operation to plot the position of the ship.

With this apparatus it has been found practicable to locate accurately the position of the survey ship at a distance of over 200 miles from the shore stations with an accuracy of about 100 yd. and to make all computations within two or three minutes from the time of explosion. Survey ships "Guide" and "Pioneer" operating last year on the Oregon coast near the mouth of the Columbia River used this method to fix the position of soundings—so successfully that similar equipment has been installed on the survey ship "Lydonia" for hydrographic surveys off the North Carolina coast.

A description of this apparatus and method in greater detail may be found in Coast and Geodetic Survey Special Publication No. 107. This publication, written in 1924, describes the first apparatus while still somewhat in the experimental stage. Some improvements have subsequently been made, principally in the line of simplification and to render the apparatus more nearly automatic. However, there have been no changes in the essential features. The most important departure is in the manner of detonating the bomb. Due probably to short circuits in the electric firing apparatus, we had two premature explosions which, fortunately, did no damage but indicated the danger of that method. At present the bomb is fired by lighting a time fuse, after which the bomb is dropped overboard, the ship moving to a safe distance before the explosion.

Arch Bridge Design of 1,100-Ft. Span Wins Over Suspension

IN A competition for the design of a highway bridge over the Rhine River at Cologne, Germany, the judges on Jan. 12 awarded first prize to a design whose central feature is a steel arch of 1,090-ft. (333.2-m.) span, and recommended it to the city authorities for execution. The winning design, submitted by the Friedrich Krupp Co. of Rheinhaused, is to cost 12,300,000 M. A suspension bridge design submitted by the Maschinenfabrik Augsburg-Nürnberg, having about the same length of span, would cost 30,000,000 M.

The river at the point of crossing, between Köln and Mülheim, is about 1,100 ft. wide between low-water banks, but is bordered on the west bank by a flood plain several hundred feet wide. It was required that a 650-ft. navigation channel be left open along the east or Mülheim bank. Most of the 38 designs submitted used a river pier just west of the specified channel, but a number preferred to use a single span over the entire low-water width of the river. The designs included arch, suspension and simple truss design; arch designs were most numerous, suspension designs next. The truss designs submitted were all of parallel-chord form.

In the prize winning design the arch ribs are box girders about 21 ft. (6½ m.) deep, tied by a built-up member in the plane of the floor. The solid-rib design won over a trussed-rib design submitted by the same company. The arches, of crescent form, are spaced 86 ft. (26.2 m.). A double-track rapid transit line and two street car tracks occupy the middle of the roadway, and footwalks are cantilevered outside the trusses. The side spans will in the main be reinforced-concrete arches of deck arrangement. Total bridge length is 2,300 ft.

For the main members of the long steel arch span it is proposed to use a silicon steel of tensile strength 68,000 to 88,000 lb. per sq.in., yield-point about 51,000, and elongation 20 per cent. The other steel members will be made of medium steel.

A Small Hydro-Electric Plant in Utah Rehabilitated

Old Installation Completely Restored and Enlarged—Rock Dam Surrounded by Concrete—Penstock Replaces Flume

By Eugene Schaub
Consulting Hydro-Electric Engineer, Logan, Utah

In 1902, Logan, Utah, with a population of approximately 6,000 voted a sum of $65,000, which was later supplemented by an additional $12,000, for the construction of a municipal hydro-electric power plant on the Logan River. This stream has a drainage area of 195 sq.mi. and a flow varying from 100 to 1,500 sec.-ft. This undertaking was completed in April, 1904, and after nearly twenty years of operation it had generally depreciated and the machinery become obsolete. In 1923 new bonds for $300,000 were issued for its complete rehabilitation. A description of the work of restoring the old plant and in installing two more units in the power house follows. In it are contained some of the problems of small hydro-electric installations.

The dam of the original plant was a rock-filled timber crib, 15 ft. high, having a crest of 56 ft. with the lower side stepped down at regular intervals to gradually retard the overflow. It is a type of low dam construction that has proven very effective in the West. The water for the power plant was diverted to the left bank into a flume 10 ft. deep by 6 ft. wide and approximately 600 ft. long terminating in a 15-ft. vertical wooden penstock. From this penstock started the 5-ft. wood-stave pipe built on an irregular grade for a distance of 6,446 ft. and supported about every 6 ft. by means of shallow fir cradles composed of 6x6-in. timber. The end of this wood-stave line was connected to a 50-in. steel pipe which formed the main distributor to two double discharge, Francis type turbines, each direct-connected to a 250-kw. 3-phase, 60-cycle, 6,600-volt Westinghouse generator; speed 450 r.p.m. The primary turbine control was effected by means of two 36-in. hand-operated gate valves.

A survey of this plant in 1923 disclosed several defects. The upper flume could have been entirely avoided by running the pipe line directly into the river forebay, thereby attaining more head, and lowering the cost of construction and maintenance of this part of the waterway. The wood cradles used in supporting the wood-stave pipe line proved to promote decay at the contact region where the surfaces could be easily penetrated 1½ in. with a penknife, while the stave adjacent to this contact surface was perfectly sound.

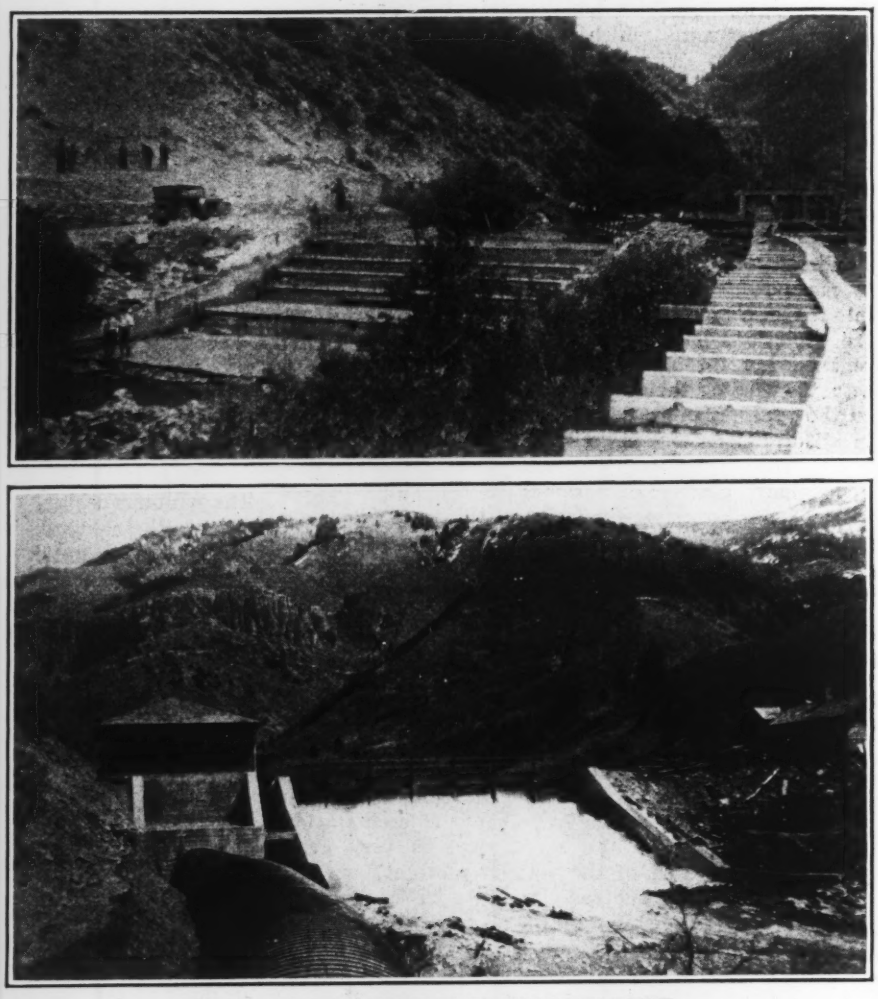


FIG. 1—OLD AND NEW DAMS ON LOGAN RIVER
Above, the old dam with the flume at the right. Below, the new dam and pipe line.

The hydraulic elements of this first waterway were very poor, because the pipe was laid too near the gradient. Therefore, the lower end of the line with its hydraulic machinery could overcharge the upper portion of the pipe, creating a vacuum in the system at full load. This condition at one time collapsed about 200 ft. of pipe.

To prevent further collapses three 3-ft. standpipes were placed in the line about 1,000 ft. from the power station. This removed the danger of flattening

the pipe but did not remove the danger of disconnecting the water column in time of maximum demand. Another hydraulic weakness in the old power plant was the 90-deg. T that supplied water to the two wheels; to compensate for this loss and to make hand-operated gate

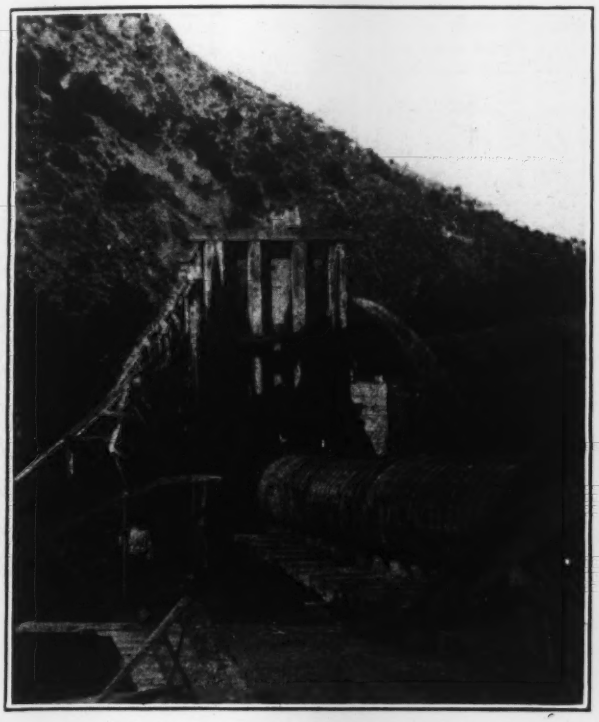


FIG. 2—OLD FLUME AND PIPE LINE

valves easier to open or close, two 2-ft. bypasses into the top of each wheelcase were provided. In the writer's opinion the only good this did was to equalize the pressure to facilitate the gate valve operation. These various conditions reduced the rated capacity of the plant from 500 kw. to an actual 350 kw.

On May 17, 1923, the writer was engaged to proceed with the specifications and design of all structures and machinery for the new plant. In the meantime the old plant was kept in operation until July 17, when the wood-stave pipe failed beyond repair.

It was decided to use the rock-filled crib dam as a part of the new structure. By referring to the drawing, Fig. 4, it will be observed that the new dam practically surrounds the old one except on the lower side. The elevation of the original crest was 5,009; the new is 5,012, with an additional 6 ft. obtained by the use of stop logs. This raised the new water surface 9 ft. above the crest of the old dam. Nine ft. was an important gain, for besides the increased head it was possible to follow the old grade in many places with the new pipe line and still be far enough below the hydraulic gradient for effective operation under a 250-sec.-ft. discharge.

The 30-ft. trash rack supported at four points, top, bottom and two intermediate points, is built of ¼x2½-in. iron bars spaced 1¼ in. center to center. The intermediate points of support are I-beams of sufficient section to safely resist the forces imposed by the entire head of 14 ft. of water. The rack is built up in sections which do not exceed 250 lb. in weight.

Of the four sluice gates, gate two, 4x6 ft., under a maximum head of 19 ft., is very uniquely placed with respect to the trash rack and inlet. During flood water this gate is kept open and its intense scouring effect keeps the silt and river run below the entrance of the lowest point of the trash rack. It is actuated by means of tandem screws in such a manner that one man can very easily raise it. Another notable feature about the gate is that its upper face is a smooth plane reducing the coefficient of friction when silt has settled against this surface. Gate three for the sand trap is similar and gate four is a small 18-in. slide that drains the escape through the large tainter gate, thereby positively lowering the water surface below the entrance to the main 78-in. line when the tainter gate is closed.

Sand Trap—Sections of the old wood-stave pipe line were badly worn away due to the erosive action of the silt-laden waters. Since effective sluicing action, which is the best way to intercept moving particles, is confined to a very limited region surrounding an opening, it was evident that a scouring action across the entire section would be a means of removing the accumulation. Such a sand trap was made by building a V-shaped trough at right angles to the direction of flow having its lower side contracted into a nozzle 6 in. wide across the entire width of the 16-ft. waterway. This nozzle then has an area of 8 sq.ft. and under a mean head of 16 ft. would have a scouring velocity of approximately 20 ft. per sec. when gate three opened. This is ample effort to completely remove the silt and sand from within the V-trough and the sluice directly underneath it, into the main large sluice and thence into the river below the heel of the dam. During periods of high water it is advisable to keep this gate partly open, while in low water the stream is free from suspended matter. The simplicity of the device can be readily appreciated since its only moving part is the 36-in. sluice gate.

A departure was also made from the usual practice in that the entrance to the wood-stave pipe is an 8x12-ft. ellipse with the major axis horizontal. This section is drawn down to a circular one to connect with the pipe in 9 ft. The center of the circle is 9 in. above the center of the ellipse to minimize air vortex. This

FIG. 3—A 20-DEG. CURVE IN THE NEW PIPE LINE

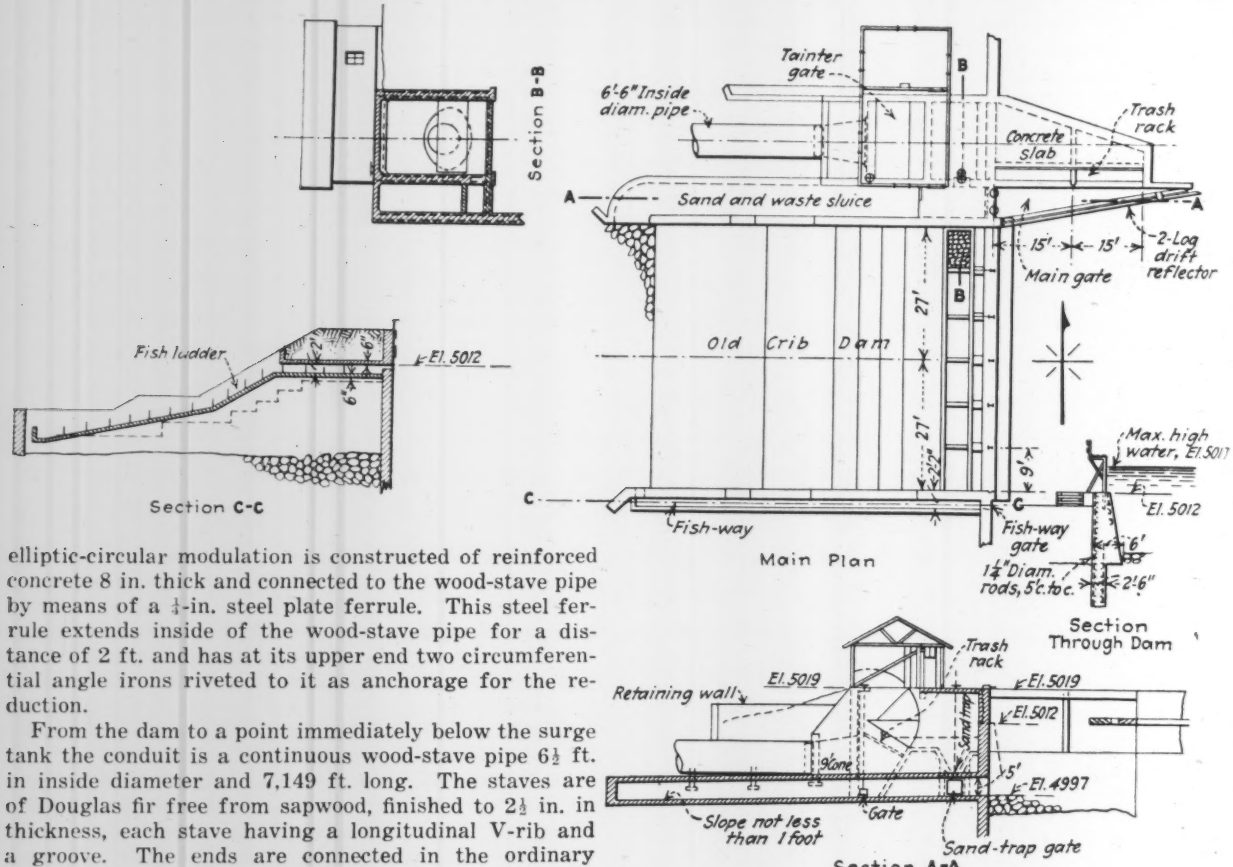


FIG. 4—DETAILS OF THE DAM

elliptic-circular modulation is constructed of reinforced concrete 8 in. thick and connected to the wood-stave pipe by means of a ¼-in. steel plate ferrule. This steel ferrule extends inside of the wood-stave pipe for a distance of 2 ft. and has at its upper end two circumferential angle irons riveted to it as anchorage for the reduction.

From the dam to a point immediately below the surge tank the conduit is a continuous wood-stave pipe 6½ ft. in inside diameter and 7,149 ft. long. The staves are of Douglas fir free from sapwood, finished to 2½ in. in thickness, each stave having a longitudinal V-rib and a groove. The ends are connected in the ordinary manner by means of the iron plate. The ⅝-in. bands are in two pieces, spaced from a maximum of 10 in. to a minimum of 6 in. at the lower end. The grade is continuously downward and is a minimum distance below the hydraulic gradient, at full load, at the intake. Since the grades decline faster than hydraulic gradient at full discharge the saturating effect constantly increases as the pipe approaches the lower end.

A maximum curvature of 20 deg. was the limitation placed in the alignment. During erection it was found that this is the sharpest curve on which a pipe of this nature can be built.

There are two 8-in. vents equally spaced between the surge tank and the dam. These are inserted in the extreme top of the pipe and the topography is such that the lines are buried up the hillside with a galvanized iron vent-hood 4 ft. above the reaction gradient. (The term reaction gradient is applied to the imaginary line drawn between the spillwater when discharging at the surge tank and the surface of the water at the dam.) Manholes were provided near each of these vent pipes.

In the substructure for the new pipe line it was decided to use a combination of concrete, wood and cast iron. The pipe was built clear of the grade by 1½ ft. The concrete sills are 1½ ft. wide by 8 ft. long, spaced 12½ ft. center to center. The load is 1.15 tons per sq.ft.

An 8x8-in. by 8-ft. local red pine sleeper is placed on the concrete sill. This timber is fastened to the con-

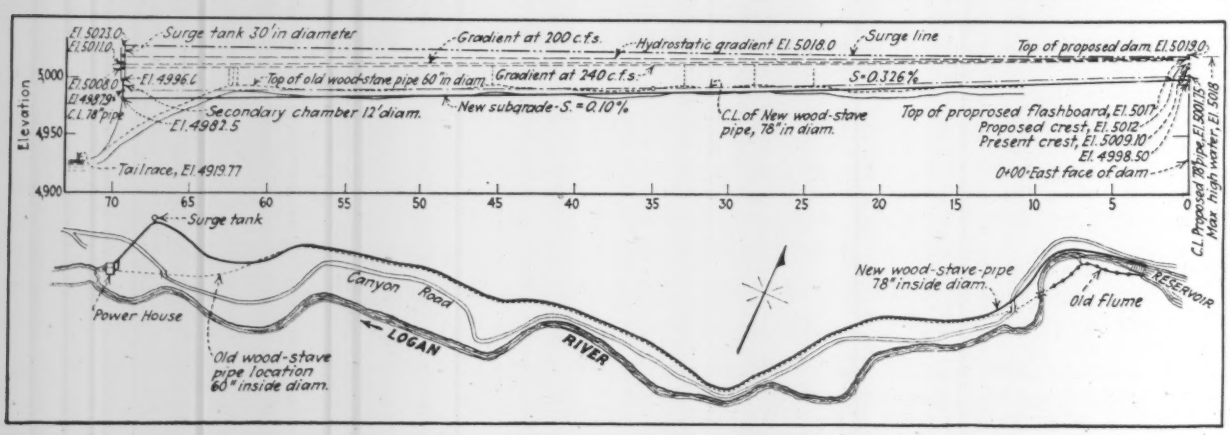


FIG. 5—PLAN AND PROFILE OF THE PIPE LINE

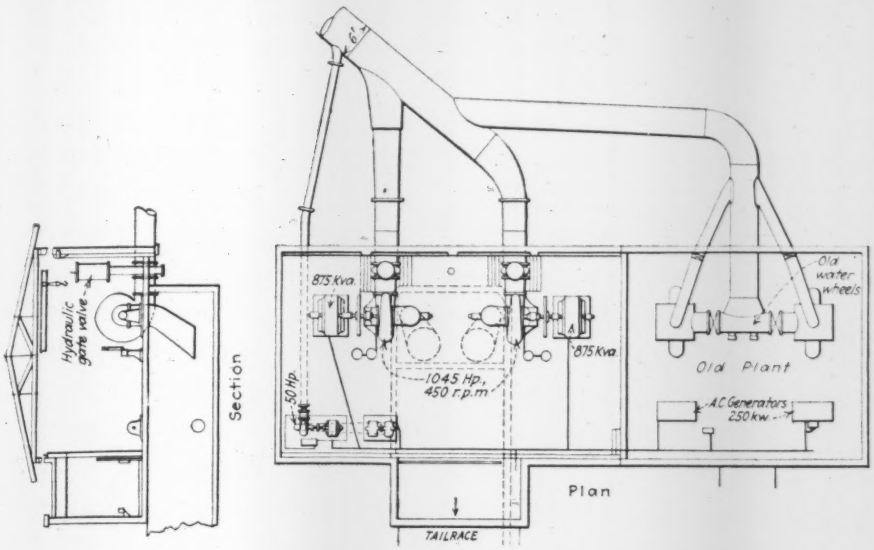


FIG. 6—PLAN OF THE POWER HOUSE

crete by two pump rod couplings, one at each end connecting the anchor bolt in the concrete to the upper insertion bolt through the timber. This arrangement makes it very easy to replace a wood sleeper. Because of the many advantages of the metallic cradle in this latitude, it was decided to use cast iron made in two parts as shown. Cast iron was offered as cheaply as steel and the maintenance cost is less. A test specimen of the cradle computed to fail at 80,000 lb. actually failed at 81,000 lb.

From the wood-stave pipe a reduction is made to the 6-ft. steel penstock. The plates were rolled and punched in the shops at Salt Lake City, Utah. Two thicknesses, $\frac{7}{16}$ and $\frac{3}{8}$ in., of plate were used, and the joints have an efficiency of 73 per cent. The weakest point in the line is computed with a factor of safety of 10 when a flow of 200 sec.-ft. is arrested in 3 sec. by the action of the turbines. The governors, however, at the present time are set to close in 7 sec.

An expansion joint was installed below the elbow near the surge tank. This joint has functioned to a maximum twice in the last two years by a movement of 2 in. with no appreciable leak. It is packed with oakum and has in it a ring of ½-in. rubber garden hose.

For the construction of the elbows and the elbow connections in the breeches the author found it necessary to derive a set of formulas for shop angles computed from the horizontal and vertical angles taken in the field.

The main chamber of the surge tank 30 ft. in diameter is abaxial with respect to the lower and secondary pipe receiving chamber which has an inside diameter of 12 ft. The functioning of this small secondary chamber can be readily appreciated when one considers the bad structural and hydraulic effects of cutting into a shell 30 ft. in diameter; in the first place a reduction in the capacity of the main tank would result by the 6-ft. pipe insertion and in the second place the structural elements would be complicated by cutting this shell.

The elevation of the tank spill is 5,023, and a 20-ft. spillway emerges into a diverting flume chamber 6x6 ft. in section. This flume section is screened and the entire structure is covered with concrete. The screened section provides for ample air admission during load changes. The tank was theoretically computed by the author to supply the demand of two 100-sec.-ft. turbines from zero load to full load during the time of water acceleration in the supply line between the tank and the forebay. Curves of acceleration and retardation were drawn for the maximum conditions.

The hydraulic machinery in the new part of the power house is brought into a well-defined zone for compactness and is readily accessible for immediate control and inspection. The turbines, right and left hand, with 30-in. bronze runners, speed 450 r.p.m., deliver approximately 1,100 hp. each. They were built by the S. Morgan Smith Co. of York, Pa. The turbines are direct-connected to an 875-kva. Westinghouse 3-phase, 60-cycle, 6,600-volt generator. The units are equipped with thrust bearings.

An examination of the turbines in the old plant showed the ends of the cast-iron buckets to be badly worn, although it was possible to build them up with an acetylene torch. The local welder did very good work making the four 22-in. runners like new at a cost of $200. The bearings were adjusted and the units reassembled for service.

The net result of this work was to increase the capacity of the plant from 500 kw. to 2,100 kw. Obsolete equipment was restored to serviceable condition and the efficiency of the old plant was increased 37½ per cent.

175,000 Hp. Possible on Salmon River

For a number of years the U. S. Geological Survey has studied the situation regarding the development of hydro-electric power on the Salmon River in Idaho. During 1912 some preliminary work was done by the engineers of the Survey with a view to determining to what extent the use of the Salmon River valley for a railroad right-of-way might interfere with the future development of water power, and at different times during 1916, 1919 and 1924 surveys of the river and of possible dam and reservoir sites were made. The results of these investigations have recently been compiled in a report entitled, "Power and Storage Possibilities of Salmon River, Salmon to Stanley." The report is in manuscript form and can be inspected at the district offices of the U. S. Geological Survey in Boise, Salt Lake City and Washington, D. C. Seven maps accompanying the report and entitled "Plan and Profile, Salmon River, Salmon to Stanley," may be purchased from the Geological Survey office at Washington for 70 cents. The report indicates that eventually nearly 2,000 ft. of fall in the river may be utilized at 19 power sites with a possible development of 84,000 hp. for 90 per cent of the time, or 114,000 hp. for 50 per cent of the time. With regulation at certain storage sites which are described in the report, 119,000 hp. could be developed for 90 per cent of the time or 175,000 hp. for 50 per cent of the time.

Pressure Wind Gages and Wind Gusts

Special Instruments Devised for Protective Use on Coal and Ore Bridges in Canada

PRESSURE wind gages have been applied to the coal and ore bridges of the Algoma Steel Corporation, at Sault Ste. Marie, Ontario, as an aid in protecting them against storm damage. They were described recently by C. Stenbol, mechanical superintendent, in a paper read before the local branch of the Engineering Institute of Canada, and published in the society's *Journal* (Oct., 1926). According to that paper and additional data supplied by Mr. Stenbol, two of the bridges at the Sault Ste. Marie plant were destroyed by wind several years ago, the wind blowing the shear-leg end along the runway ahead of the lower end and twisting the span to the ground. The requirements of tornado insurance companies specify that bridges must be fastened to their track except when moving, and that they must not be moved in wind exceeding (for most bridges) 35 m.p.h.

Therefore, because of the variations of storm winds and the disagreement between the various authorities and makers of anemometers as to the relation of wind pressure to wind velocity, the corporation has experimented with many forms of gage, and has finally developed plate pressure gages of two forms, both of which are now in use at the plant.

The first, or pendulum type, Fig. 1, has been mounted on all the bridges. It has an oblong plate about 6x24 in. in size, hinged to a yoke placed at the front end of a wind vane so that it always faces in the direction of the wind; under wind pressure the plate swings, its angle increasing with the pressure, and at a predetermined wind pressure it touches an electric contact which signals the bridge operator that the wind has reached the allowable limit. Some forty bridges at the head of the lakes have been equipped with this gage. The second type of gage, Fig. 2, has a circular pressure plate of about 1½-sq.ft. area carried by parallel-motion levers so that it is held vertical at all times; increasing wind pressure merely pushes it back. This type has been worked out for recording on a clock-driven chart the wind pressure and direction. In both types, pressure plates are No. 16 galvanized steel, painted.

Tests were made on an automobile, run at speeds from 20 to 40 m.p.h. The lever-mounted vertical plate gave pressure coefficients averaging 0.0033 between 25 and 40 m.p.h., though at 20 m.p.h. a higher coefficient, 0.0040, was obtained. The pendulum or swinging plate gave coefficients increasing from 0.003 at 20 m.p.h. (swing 23 deg.) to 0.0058 at 40 m.p.h. (swing 60 deg.). These tests were to establish the relation between pressure and velocity. The actual calibration was carried out by dead weight.

Mr. Stenbol adds some instructive remarks on wind gusts and peaks, and brings out the sway or resonance effect of guests: "Sir Douglas Mawson [the Antarctic explorer] emphasizes the destructive work of gusts or wind peaks. The writer has made many observations, and will mention an example watching the behavior of the wind from the cab of one of the bridges. It was plainly noticeable (the wind peaks were just touching the 35-mile mark), that the gusts at times were coming with equal regularity, just as if they were trying to time the sway of the bridge. Once or twice it was done to such a nicety that it appeared that the sway of the bridge was sounding the alarm rather than the wind.

"In guarding structures against wind damage, the

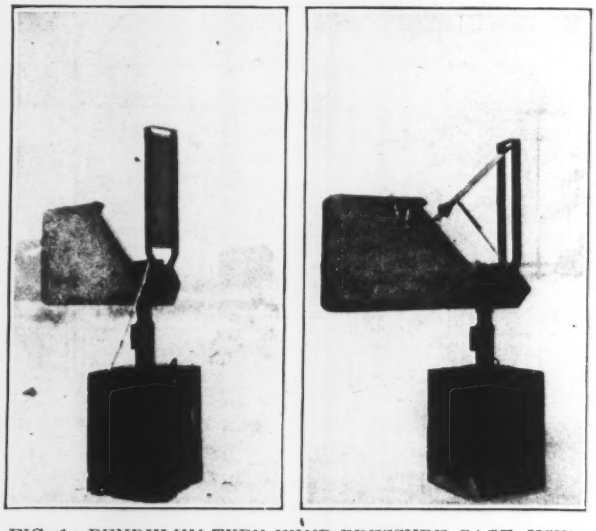


FIG. 1—PENDULUM-TYPE WIND-PRESSURE GAGE, USED ON A NUMBER OF UNLOADER BRIDGES

At left, pressure-plate vertical (no wind blowing); at right, pressure plate deflected (as in a high wind). The gage is mounted at the front end of a wind vane. A limit contact at the upper end of the swing, with enclosed silver contact points, gives an electric warning signal at a fixed wind pressure. The electric wiring is enclosed.

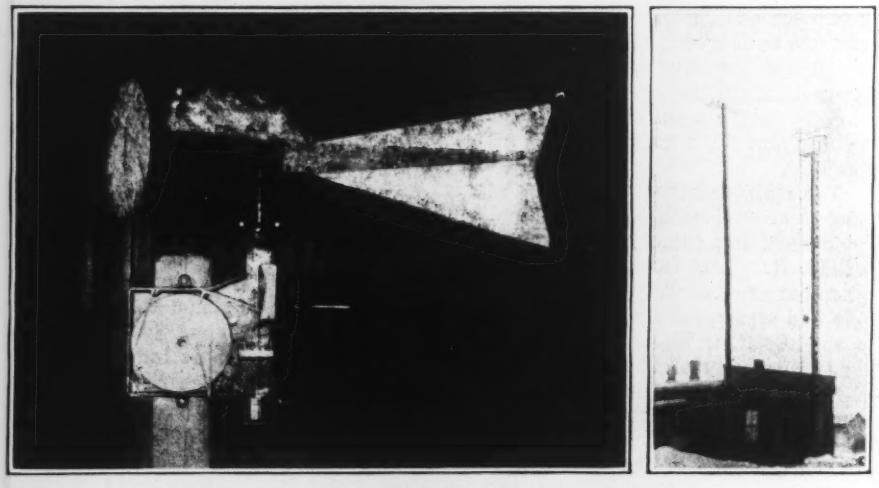


FIG. 2—PARALLEL-MOTION WIND-PRESSURE GAGE

At left, on calibration stand; at right, mounted on 55-ft. mast at steamship office. Upper pen is velocity or pressure recorder, lower pens are direction recorders.

maximum peaks must be considered, as they are really more destructive than a steady wind of equal velocity. Thus, in the case cited above the gusts added to the momentum and each time put greater stress on the swaying structure until, fortunately, the timing of peaks changed and normal loading was again established. The action is probably best seen by watching exposed tall trees in a storm. They sway back and forth, and sometimes they sway back apparently beyond their normal position, and if the wind catches them again at that moment, it seems that it forces them with doubled power towards destruction. Another action of the wind is to produce momentary peaks at long intervals. It has been noticed, particularly in an abating wind, that the velocity of the wind sometimes increases after 20 to 30 minutes, with one or two peaks equal to its original force.

"* * * If the behavior of the wind direction is studied it will be found that, like the velocity, it is by no means steady. One of the two bridges lost some years ago was from a momentary gust, and from the opposite direction to the original wind, and it came after everybody thought the storm was over. This was an exception, but these exceptions must be guarded against."

Florida Hurricane Damage as Seen by a Building Official

Faulty Application of Materials the Main Cause of Loss—Anchorage and Bracing—Should Design for 30-Lb. Pressure

By L. F. Fletcher
President, Building Officials Conference of Florida, Orlando, Fla.

After the Southern Florida hurricane of Sept. 18 it was possible for any one with a camera and notebook to go into the storm area and prove by particular selected cases that any one type of building material stood the storm well. The writer has had opportunity to study the situation and has discussed it with many building officials in the state, as well as with engineers of national reputation, and the facts given below represent the resulting conclusions in brief.

The severity and intensity of the disturbance varied greatly in different sections of the damaged area; at one point a well constructed building is found totally destroyed, while possibly 100 ft. away a shack remains undamaged. It is therefore difficult to define the severity of the storm and decide what degree of strength should be provided to secure resistance against similar storms. However, from broad study of the facts, it becomes plain that 80 per cent of the failures were due not to the materials used but to the method of their application.

Frame Construction—Frame construction as a whole stood the storm well. Failures occurred in buildings which were not properly corner-braced, and, in the case of buildings with weatherboarding, where one nail only was used in each stud. The small expenditure necessary to provide corner bracing and adequate nailing would have changed many structures from poor to well constructed buildings. In many instances roofs were lifted off whole and carried away; often this would not have occurred if all vents into the attic space had been of the same area. More and larger nails in attaching rafters to plates, or steel anchors, would also have helped.

Adequate anchorage of the frame structure to a suitable foundation is both important and difficult. Cellars are rarely used in the climate of southern Florida, and it has been customary to start the foundation virtually at the surface. To change this practice in favor of a foundation heavy enough to hold the building down is likely to meet with objections on account of increased cost of construction.

Brick—In the storm area brick construction was little used. So far as used, however, it upheld its old reputation of being one of the better materials for ordinary construction.

Concrete Block—Concrete building units were common in this section, being a local product and of reasonable cost. Unfortunately, there were many failures of buildings using such blocks, and the public at large considers them to be failures of the block. This is not the case. I observed no case of broken block but only failure of the mortar joints. The blame for this is about evenly distributed between poor mortar and the practice of laying up the blocks dry so that they absorbed all the moisture from the mortar, taking the life out of it. Often the blocks themselves were partly at fault, as they were made of too dry a mixture and were highly absorptive.

In a particular case, a small store building whose south wall still stands shows the blocks in position but minus all the mortar in the joints. The wall looks as though a giant had shaken it loose, a demonstration of the tremendous impact of the rain and gusts of wind, which, rather than steady wind pressure, did the principal damage.

Concrete unit construction can be made good by the use of less absorptive blocks and educating the builders to use strong mortar and lay the blocks moist.

Tile—Clay tile suffered for the same reasons as concrete block. If the tile used in this state were of the same quality as those used in other parts of the country, they would have made a better showing. Unfortunately, the tile manufacturers seem to think that Florida does not deserve their good products, and rarely do I see a piece of tile on which the maker cares to place an identifying mark. It will be necessary for tile manufacturers to use considerable eloquence to convince the people of this state that clay tile is as good here as it is in other sections of the country.

Parapets and Curtain Walls—Parapets suffered perhaps more than any other building element. Catching the full force of the wind and with nothing to bind the top together and nothing to brace them laterally, they were carried away generally to the roof line and often below. Parapets may be made much more secure by the use of a reinforced-concrete coping; this is being done in all reconstruction work.

Curtain walls suffered greatly, due to lack of bond between frame and wall. Care in designing will remedy this defect.

Reinforced Concrete—Reinforced-concrete construction fared well, and what few failures were seen resulted from ignorance or carelessness in the amount and placing of reinforcement. In several instances of long buildings, no attempt had been made to provide lateral bracing.

Steel Frame—Steel-frame construction performed much better than might be expected considering the wind pressure used in design in comparison with that

developed by the storm and the impact of rain and gusts. In the one well-known failure of a tall building, examination showed that the field workmanship, while not perfect, did not cause any failure. The elastic limit of the columns had been exceeded, bending them close to the girder connections and thereby throwing the framework out of plumb.

Calculations are now being made to compare buildings which were not damaged and those that show the most damage. Pending completion of these, I would not hesitate to say that if buildings were designed for 25 or 30-lb. wind load rather than 20 as has been customary, no damage would result to the structural frame. This conclusion is partly borne out by the result in Havana after the Oct. 20 hurricane, which was of about the same intensity as the September hurricane that visited southern Florida. Havana's larger buildings were designed for a 30-lb. wind load and were not damaged structurally.

The Florida storm was the most intense on record in this country, and, although a 20-lb. wind load has proved sufficient up to the present, I would suggest raising the design figure to 30 lb. in such storm areas.

Roofs—Roofs suffered greatly, and perhaps they are one of the hardest problems in his section for the future.

Cement and clay tile roofs, which were very common, suffered greatly, for several reasons. Much injury resulted from flying débris. In many cases damage resulted because the first course had been laid with no attempt to close the opening under the tile, and the wind was able to get under the tile. Third, there was usually insufficient anchorage, due to the common design of tile roofs using nailing strips and from one to two nails in each tile. The nailing strips being usually only ⅛ in. thick often prevented the nail getting a sufficient hold to secure anchorage. These roofs may be much improved by providing a different method of attaching, laying mortar and filling first-course openings.

Composition roofs suffered greatly except where the butts had been cemented or locked in place. A great deal of research work could be done in this climate (which is very hard on this type of roofing).

Wood shingles stood up very well, and if some method of removing the fire hazard could be devised, I believe they would be a valuable asset in hurricane regions. Until such time as this is done, I would hesitate to recommend them to overcome a condition that may occur, perhaps, only once in a decade while creating an ever-present fire hazard—except in isolated buildings or localities where the fire hazard is negligible.

Windows—In all structures windows suffered tremendously, especially where large panes of glass were used. Where sash were divided, the results were much better. Shutters such are common in New England, would be a great advantage in a storm area.

In summary, the writer believes that, considering the great amount of hasty construction that had been done here during what many people call our real-estate boom but which is better spoken of as our gamblers' convention, and considering the severity of the storm, structures on the whole performed much better than might have been expected. It is evident, however, that too much stress cannot be laid on proper building inspection by both architects and municipalities. This, I believe, was clearly demonstrated in Coral Gables, which passed through the storm with little structural damage.

Steamed-Cured Cylinders Give 28-Day Concrete Strength in 48 Hours

Method Used to Control 45,000 Cu.Yd. of Concrete Where Aggregate and Cement Qualities Were Variable

By M. S. Gerend
C. C. Moore & Co., Engineers, San Francisco, Calif.

On a paper mill building program, covering a period of three years and calling for the pouring of some 45,000 cu.yd. of concrete, it has been necessary to maintain an accurate control on concrete strength since there was considerable variation in the character of available cement and aggregates. This variation resulted in a 28-day compression strength varying from 1,100 to 2,950 lb. per sq.in. on different specimens. Because of this wide variation, it was desirable to determine concrete strength as soon as possible after the concrete was poured, the regular 8- and 28-day tests being somewhat in the nature of locking the stable after the horse had been stolen. A very satisfactory method of testing was devised in which the concrete specimens, being subjected to steam pressure shortly after casting, were able to be tested within 48 hr.

The steaming chests in which the specimens were placed were made of wrought-iron pipe as shown in the accompanying illustration. A recording steam pressure gage was connected with the steam line behind the control valve in order that a record would be made of the length of exposure to steam and of the pressure during exposure. This pressure varied between 80-lb. and 125-lb. gage but averaged close to 90-lb. A steam trap was used to remove the condensation from the steam chests in order that the test pieces would be evenly and regularly steamed. The test pieces were placed in the chest on a slide made of galvanized iron with rolled edges. This also acted as a baffle for the test piece that was near the steam inlet. The steam chests were roughly bricked in and were covered with a steel plate.

After a few tests made it was evident that the acceleration of the curing of the test pieces was very much influenced by variations in the pressure and quality of the steam as well as by the length of exposure to the steam. It was, therefore, found necessary to use a pilot test cylinder with the regular test cylinder, the compressive strength of the pilot cylinder at 28 days being known. The regular routine called for four test cylinders, of which two were steam-cured and two were kept for test after 28 days of normal curing. Two pilot cylinders were prepared to accompany each pair of test cylinders. These four cylinders were treated alike in all respects in order that identical curing conditions would hold for all four cylinders. Due to variation in the exposure to steam, the cylinders after steaming were at varying percentages of their normal 28-day strength, but it appeared reasonable to suppose that the ratio of the strength of the test and pilot cylinders would hold constant even under a fairly wide range of curing conditions.

Making the Pilot Test Cylinders—It was soon discovered that extraordinary precautions were necessary in order to make pilot cylinders that were of standard quality. Refinements were introduced into the construction of these pilot cylinders until it was possible to turn them out with a variation in strength of less

than 5 per cent plus or minus. Cylinders made from ordinary materials and with ordinary careful proportioning were found to vary as much as 50 per cent in strength.

The following steps were taken to insure pilot constancy and all of them are of first rate importance. The cement used was tested bag for bag for soundness by

STEAM CHEST ARRANGEMENT FOR RAPID CURING OF CONCRETE TEST CYLINDERS

one-hour high pressure steam curing. Cement will vary in quality between bag and bag even when taken from the same bin at the cement mill. To insure a constant strength of cement twelve bags of cement which had passed the steaming test for soundness were very thoroughly mixed and then stored in airtight containers. A group of twelve cylinders were then made up and these were broken after 28 days of normal curing. The average of the 12 breaks was taken as the strength of that particular batch of pilot cement.

Enough fine aggregate to mix with the 12 sacks of pilot cement was chosen. This aggregate was as clean as could be obtained but individual samples varied from about 0.5 to 1.0 when tested by color for organic matter. This variation undoubtedly had considerable influence on the variation in strength of the pilot cylinders.

The coarse aggregate was chosen from a lot that was free from all coatings both organic and inert. All fines below four mesh were screened out, and some of the intermediates were eliminated in order to make up an even grading from four mesh to 1½ in.

In proportioning and mixing the pilot cylinders 1,575 grams of cement, 840 c.c. of water, 6.94 lb. of dry fine aggregate and 16.63 lb. of course aggregate were used for a 6x12-in. specimen. The coarse aggregate was screened and regraded as follows:

Passing	1½	in. and retained on	¾-in. 9.44 lb.
Passing	¾	in. and retained on	⅜-in. 4.75 lb.
Passing	⅜	in. and retained on	¼-in. 2.44 lb.

The pilot cylinders were mixed singly by hand for a period of 1½ min.; the resulting mixture had a 6-in slump. A small cube mixer would probably have insured more uniform mixing.

It was found both convenient and satisfactory to steam the test pieces and pilot cylinders for a period of 12 to 15 hours, after they had been cured at about 70 deg. for 24 hours. A longer period of steaming resulted in a concrete strength that was too high for convenient breaking by the apparatus at hand and a shorter period at times resulted in cracked test pieces. This may have been due to cement which would test unsound by the one-hour high pressure steam test. The cooling down of the cylinders was extended over a period of an hour, and no shattering was experienced if the steaming had extended over a period of ten or more hours. Shorter periods or interrupted periods of steaming were found unsatisfactory and it became evident that a graphic record of the steam pressure was of prime importance.

These test methods through a series of upward of 500 tests have apparently proved their worth both technically and commercially. There have been no consistent differences between the 28-day strength and the strength predicted by the steam curing method, a per cent variation of about 5.25 being rated on twenty specimens picked at random. It has been generally assumed that a poor concrete will be improved by steam curing by a greater per cent than a strong concrete. Our experience with the above tests neither proves nor disproves this assumption. As a whole the tests covered concrete of a nominal 1:2:4 to a 1:3:6 mix.

Conclusions apparently established by these tests are:

(1) Concrete after first an initial set of 24 hours at room temperature and then an exposure of 12 hours in a saturated steam bath, at 80 to 100-lb. pressure, will have reached a strength in compression approximating that obtained after 28 days of normal curing in a damp closet.

(2) Two different batches of concrete, providing they are approximately alike in makeup and age, will, after a common exposure to a steam bath, have reached a certain common percentage of their 28-day strength in compression.

(3) If the 28-day strength of one batch of concrete is known, the strength of a second batch can be estimated by comparing their strengths in compression after having received like steam treatment; i.e.:

Test cylinder after steaming : Pilot cylinder after steaming: :
Test cylinder at 28 days : Pilot cylinder at 28 days

(4) Provided proper precautions are taken it is possible to reproduce test cylinders of concrete which will not vary over 100 lb. in compression at 28 days.

(5) When using the test method discussed above, under field laboratory conditions, it will be possible to forecast the 28-day strength in compression of a concrete within less than 48 hours after it has been poured.

(6) The discrepancies in the forecast should not exceed 250 lb. with an average difference of not over 100 lb.

(7) This method is both faster and more accurate than an estimate based on a 7-day test.

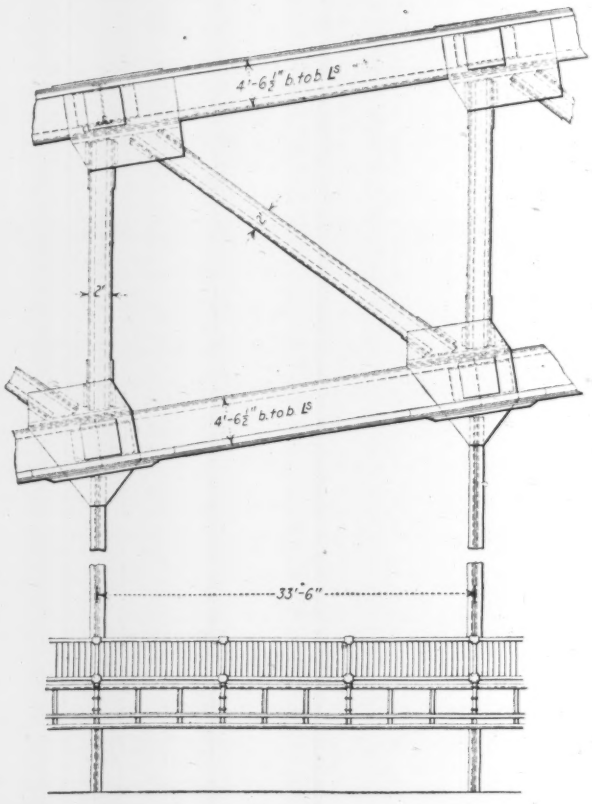
Valuable assistance was given the writer in working up this test method by J. T. Fullerton and F. Feeny.

Great Steel Arch Bridge Planned for New York Harbor

Study of Kill van Kull Crossing for New York and New Jersey Shows Traffic Justifies $16,000,000 Structure

TWO crossings of Arthur Kill, between Staten Island and the New Jersey mainland, are now under construction. The Hudson River is to be spanned at 178th St. to Fort Lee, work being likely to start this season. A fourth bridge has been authorized by the legislatures of New York and New Jersey, to cross Kill van Kull between the south tip of the Bayonne peninsula and the town of Port Richmond on Staten Island (Richmond borough of New York City). Design and cost studies show that the bridge will pay, and it will probably be undertaken in the immediate future. All four bridges are toll-refunding enterprises and are being built by the Port of New York Authority.

Tentative designs for a highway crossing over Kill van Kull, between Bayonne, N. J., and Port Richmond, Staten Island, New York City, have been prepared by the Port of New York Authority, as briefly reported last week (p. 255). The study was made under resolutions of the legislatures of New York and New Jersey, which a year ago empowered the Port Authority to build and operate a bridge. An arch bridge of 1,600 to 1,700 ft. span, shown by sketches herewith, is found to be best suited to the location. It will be by far the largest arch in the world except for the 1,650-ft. Sydney Harbor arch bridge now under erection; it will be 700 ft. longer than the Hell Gate arch and about twice as long as the Upper Niagara arch bridge.



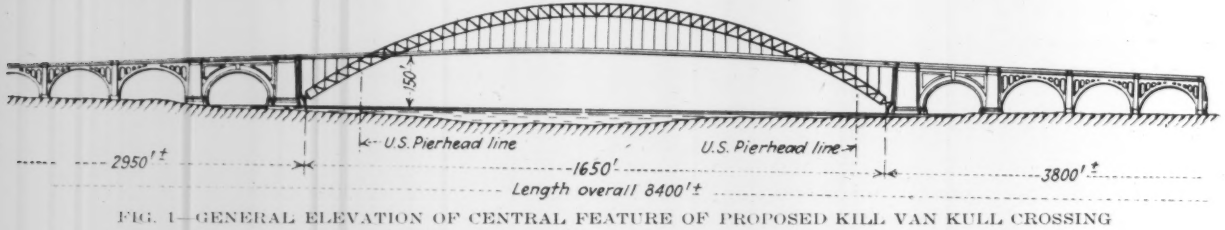


FIG. 1—GENERAL ELEVATION OF CENTRAL FEATURE OF PROPOSED KILL VAN KULL CROSSING

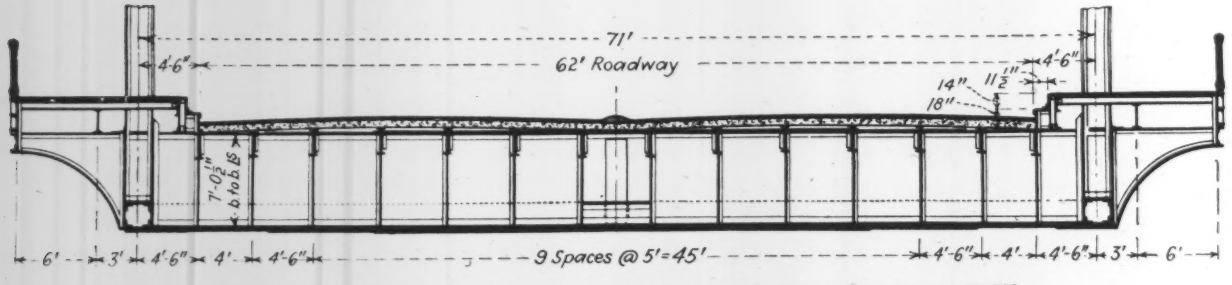


FIG. 2—TWO SEPARATE ROADWAYS CARRIED ON 62-FT. SUSPENDED DECK

Kill van Kull channel, separating two populous suburban districts, is a commercial waterway of major importance in the New York harbor system, since it connects the Upper Bay with Newark Bay and (in conjunction with Arthur Kill)) constitutes the inside passage around Staten Island and thus is a direct route to the Lower Bay, back of Sandy Hook. It is 1,600 to 1,700 ft. wide between pierhead lines. At present a ferry crosses the Kill, but it is overtaxed at times of peak traffic and is generally conceded to be inadequate for the potential traffic between Bayonne and Staten Island. An adequate highway crossing at this point, it has long been recognized, would form a new and very valuable through route from New York to the main highway south and west. The investigation revealed that the traffic is so large as to make the crossing highly profitable, and accordingly the Port Authority will probably soon undertake its construction.

Studies of traffic received primary attention in the investigation. They included the studies made two

years ago (preliminary to the design of the Arthur Kill bridges at Tottenville and Elizabeth, now under construction) of ferry traffic at Perth Amboy, Carteret, Elizabeth, Bayonne, and Bay Ridge (Brooklyn). Additional traffic counts were made last year, covering the Bayonne, Whitehall, 39th St. (Brooklyn), and Bay Ridge ferries. It was found also that the Bayonne-Port Richmond ferry across Kill van Kull has reached capacity during peak hours and the rate of increase of traffic has been less than at other ferries, presumably due to the capacity limit. Based on these observations estimates of future traffic over a bridge crossing Kill van Kull were made. For 1932 (assumed year of opening of bridge) the traffic is estimated at 1,261,000 private vehicles and 299,000 buses; for 1940, 3,130,000 and 740,000; and for 1950, 6,776,000 and 1,604,000. At toll rate of 60c. average per vehicle, these would yield gross revenue increasing from $1,253,000 to nearly five times that sum, or a net revenue available for interest and amortization increasing from $1,100,000 to more than $5,500,000 (income percentages of 6.90 to 34).

Rail service across the bridge is not believed necessary or desirable, at least at present. The cost of the structure would be nearly doubled and this increase would not be justified by the returns.

No final location for the crossing has been selected, but several possible sites were found. At all of them rock is found at the surface on the Bayonne side, while on the Staten Island side core borings show hard granite at moderate depth below water. These conditions are favorable for an arch crossing, since abutments to rock are easily and cheaply built, and in fact comparative designs for cantilever, suspension, and arch bridges showed the arch design to be most economical. A single span over the full width of the waterway was contemplated in each design. The dredged navigation channel is now only 400 ft. wide, but it will probably be widened in future. A clearance height of 150 ft. was chosen for the purpose of the study, but this height may be increased if navigation interests require an increase.

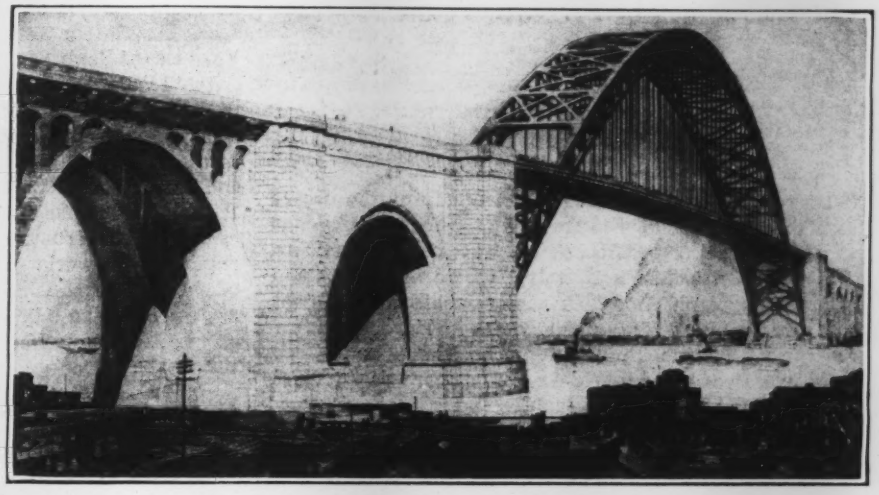


FIG. 3—ARCHITECT'S PERSPECTIVE OF ARCH

The Port Authority has reported to the legislatures, on the strength of the findings of its bridge engineering staff, that "a single steel arch flanked by concrete arch viaducts for the approaches is not only lowest in cost but also of superior esthetic merit." This structure, shown by the general drawings and perspective herewith, has a span of 1,650 ft. c. to c., a rise of 260 ft. c. to c., and a crown depth of 34 ft.; it will be understood that span, height, and other features are merely tentative for the purposes of the study, and are likely to be modified in the final development of the design.

Cost estimates indicate that this arch bridge, with four-lane roadway for highway traffic only, can be built for $16,000,000, including real estate and interest during construction. The net income percentages above given are based on this cost figure.

The design was developed under the direction of O. H. Ammann, bridge engineer of the Port Authority, with the approval of William H. Burr and George W. Goethals, consulting engineers, and Cass Gilbert, architect. Robert A. Lesher is traffic engineer and Allston Dana is engineer of design.

Bills are now before the New Jersey and New York legislatures to appropriate $400,000 annually by each state, for five years, as a loan contribution to the cost of this bridge, making a total of $4,000,000. The remainder of the cost is to be financed by the Port Authority as in the case of its three other bridges, by sale of bonds secured by toll revenue. Tolls are to be collected until the bonds are amortized.

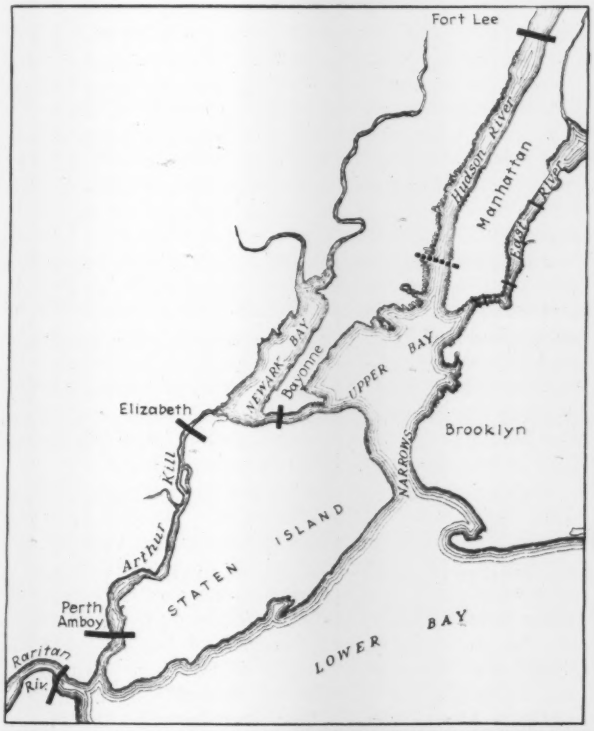


FIG. 4—NEW YORK HARBOR'S NEW INTERSTATE BRIDGES

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Linings of Pressure Tunnels

REVIEWED BY I. GUTMANN
Research Engineer, Sanborn & Bogert, Consulting Engineers, New York City

DIE AUSKLEIDUNG VON DRUCKSTOLLEN UND DRUCKSCHACHTEN—Von Dr.-Ing. Otto Walch, Oberingenieur der Siemens-Bauunion. Berlin: Julius Springer. Paper; 6x9 in.; pp. 188; 93 line drawings and halftones, and 5 plates of data on completed pressure tunnels and pressure shafts.

Doctor Walch's book treats principally of the design and construction of linings of pressure tunnels and shafts (including penstocks) as practiced in Germany, Austria, Switzerland and Italy. There are also about a dozen pages on American achievements in this field, but practically nothing about works in European countries west of the Rhine, notably France and Great Britain. Pressure tunnels—aqueduct tunnels carrying fluids under pressure—are subject both to the outward pressure of the fluids conveyed, and, when empty, to the inward pressure of the ground water or earth loads. These combined forces, which do not readily lend themselves to analytical determination, are generally resisted by the tunnel linings.

The first sixty pages of the book are given to a description and discussion of the stresses in the lining. The thermal stresses and those due to water veins, to the pressure, elasticity and plasticity of the surrounding rock formations are discussed fully but only in a general qualitative manner. The author does not consider elaborate theoretical formulas of much practical value; he therefore does not reproduce them, but merely states their underlying principles of analysis and refers the interested reader to the original sources. On the other hand, great stress is placed on the results of quantitative experiments and observations on tunnels built for use. Dr. Walch reports in detail results of the classical investigations of the Swiss Tunnel Commission and experiments made by the Berlin firm, Siemens-Bauunion, presumably under the direction of the author. These experimental studies on the elastic behavior and permeability of tunnel linings are remarkable for their scientific refinement and rank with the tests on the experimental arch dam built by the Engineering Foundation on Stevenson Creek in California.

The remaining two-thirds of the book describes existing works, classified as to material of construction. There is introduced a general discussion of linings of tamped and gunned concrete, grouting methods, metallic linings, timber linings, and concrete jackets with metallic cores. There is also a section on the utilization of abandoned drifts and tunnels for the purpose of storing compressed air. When lined these serve as storage reservoirs of pneumatic power for operating mining machinery. A laboratory study of the stresses in tunnel lining by means of a model which consisted of an iron pipe about 33 in. in diameter, lined with reinforced concrete, is described.

The book closes with four pages of international bibliography and five sheets of detailed tabulation of the data on 86 existing pressure tunnels, shafts and penstocks. In looking over the American section of the bibliographic list one misses such important works as Lazarus White's "The Catskill Water Supply of New York City," Sanborn and Zipser's "Grouting Operations, Catskill Water Supply" and Donaldson's "Practical Shaft Sinking." The list of existing tunnels does not include some important American and British structures, such as the Colorado siphon, the Davis bridge shaft spillway, and Mersey River tunnel of Liverpool water supply.

American engineers will find in this book many interesting and instructive data on European practice and experimental work. It presents a collection of studies of successful precedents which will be found invaluable as a practical guide and aid to judgment in a branch of engineering in which seasoned judgment is, after all, the most reliable guide.

Characteristics of Tropical Cyclones

TROPICAL CYCLONES: Comprising an Exhaustive Study Along Entirely New Lines of the Distribution of Wind Directions and Velocities, Clouds, Precipitation and Other Features Observed and Recorded in Sixteen Tropical Cyclones Which Have Moved in on the Gulf and South Atlantic Coasts During the Twenty-five Years, 1900 to 1924 Inclusive, With Deductions Concerning the Causes of the Distribution of Winds and Precipitation in Cyclones, the Development and Movement of Cyclones, and the Passing of the Cyclone from the Tropical to the Extratropical Latitudes—By Isaac Monroe Cline, M.A., M.D., Ph.D., Senior Meteorologist, U. S. Weather Bureau; Fellow of the American Meteorological Society. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 301; maps and diagrams. $5.

Gulf or West Indian hurricanes constitute a peculiar anxiety of the engineer concerned in the upbuilding of the southern coastal cities, and every few years a disastrous visitation again demonstrates their dangerous character, as most recently the great Florida storm of September. The intimate dependence of many engineering problems upon these phenomena of nature is plain. Therefore we need to know about them, and whenever the students of weather and wind push forward their studies of these storms, engineers should learn of their findings. Dr. Cline's work accordingly has a strong engineering appeal, though written from the weather man's viewpoint and for an audience of meteorological scientists.

Its appeal lies not only in the fact that he presents new conclusions, which define and describe the cyclone characteristics better than before, but also in his use of a novel and powerful form of statistical analysis to reach these conclusions. The analysis is remotely like that employed years ago by the Miami Conservancy engineers in extending their flood statistics far beyond the available period of experience. It consists in suitable geographic integration of observations.

Sixteen tropical cyclones observed between 1900 and 1922 furnish Dr. Cline's material. For each one he assembles the data on wind direction and velocity, precipitation, and cloud direction, on the co-ordinates of the moving storm; in other words, the successive observations at each station are transferred to the ground plan of the storm in proper relation to the instantaneous position of the cyclone center and axis of advance, and are assembled on this plan as though they were simultaneous observations. The warrant for this process rests on the assumption of constancy of main

phenomena. Of course the results themselves are bound to reveal whether the assumption holds true, and in Dr. Cline's case the results prove it to hold. Moreover after integrating each storm separately in this way, he finds it possible also to integrate the several storms in three or four groups. In turn, these groups have such close similarity that suitable change of scale would apparently have permitted their integration into a single combined diagram of cyclone phenomena, though this step is not carried out in the book.

It seems that this integration method has not previously been applied to cyclone observations, and we therefore find that the picture of cyclone action is improved, amplified and made more precise than heretofore. Had the author included the data of last September's hurricane, he might possibly have obtained an even fuller and truer picture.

His conclusions require to be read in full, of course. But to indicate their trend we may note the following: Cyclones are far from being simple anti-clockwise whirlpools of air. They are not symmetrical, though generally circular, and have a steeper pressure slope near the front (usually the right quadrant) than elsewhere, while in the left rear quadrant the isobars usually bulge out. In the right rear quarter the wind forms a straight, steady and powerful forward current; just in front of the center this current encounters a sharp inward cross wind. In the left half the wind is much lighter and more nearly curves around the center. Wind velocities are greatest in the right rear quarter, but the wind is most gusty (and most dangerous?) in the right front quarter. In this latter region also the heaviest precipitation occurs, fairly close to the storm center. Here also the energy supply of the cyclone is constantly renewed, by the action of vertical currents resulting from the cross wind, in conjunction with the effects of precipitation.

Of further interest is this passage: "In the right front quadrant the winds blow intermittently in sudden, narrow and powerful gusts, lasting but a few seconds. The sudden gusts are from varying directions, and they have a much greater velocity than the greatest single mile velocity. These sudden gusts appear to have an ascending or lifting action. In the larger cyclones the gusts are noticeable when the cyclonic center is 100 to 150 miles distant and in the smaller cyclone when the cyclonic center is 50 to 100 miles distant."

There is separate importance in Dr. Cline's generalization that the often described outward movement of cirrus clouds over the cyclone center does not occur. In small cyclones the cirrus clouds move transversely, showing that the storm is not over say 5 miles deep; but in the larger cyclones the cirrus clouds move in the direction of the storm path, and these storms must be much deeper. The lower clouds generally move in the direction of the surface winds.

For Students and Workers in Concrete

CONCRETE PRACTICE: A Text Book for Vocational and Trade Schools—By George A. Hool, S.B., Professor of Structural Engineering, University of Wisconsin, University Extension Division; and Harry E. Pulver, B.S., C.E., Associate Professor of Structural Engineering, University of Wisconsin, University Extension Division. New York and London: McGraw-Hill Book Co., Inc. Cloth; 5x8 in.; pp. 369; 158 halftones and line cuts; illustrated; appendices. $3.

One of the most important needs in concrete is to educate the foreman and the worker as to the developments which have been so important a factor in producing good concrete. It is a fact that the knowledge regarding concrete is far ahead of the practice. Such a book as this is calculated to raise the standards of that practice. Directed primarily to the students in vocational and trade schools its method of presentation lends itself readily to home study and particularly by those who by day are actually working in concrete. Nor is it too elementary for the more advanced student or practitioner. Concrete making is a practical subject, which needs practical treatment in a textbook. The authors have kept that in mind, but have also included enough of the theoretical to cover the studies that have done so much to make the production of good concrete more understandable.

Recent Progress in Sewage Treatment

REVIEWED BY ABEL WOLMAN
Chief Engineer, Maryland State Department of Health, Baltimore, Md.

FORTSCHRITTE DER ABWASSERREINIGUNG—By Dr.-Ing. K. Imhoff. Zweite Auflage. Berlin: Carl Heymanns. Boards, cloth back; 5x8 in.; pp. 136; 65 halftones and line cuts. 5 reichmarks in Germany.

Dr. Imhoff, in the second edition to his interesting and valuable volume of 1924, preserves the style and the intent of the earlier book by presenting a running commentary on the progress in sewage treatment during the past 12 years, with sufficient additions to bring the data up to June, 1926. The present edition has the advantage of preserving the consecutive and brief summaries in the 1924 issue, while adding the subsequent two years' experience in such form and placement within the volume as to make ready reference thereto a matter of simplicity to the reader. Since the progress in sewage treatment during the past two years falls largely within the realm of addition, rather than emendation, to the processes discussed in the first edition, the additions to the text are made in each case at the end of the chapter, easily located and permanently separated from the earlier portions of the text.

The more important additions refer to the two-story tank installations at Munich, with a brief but clear discussion of the modifications in these designs from the Emscher arrangements; to separate sludge digestion developments in Germany and the United States in 1924-26; to the collection of gases of sludge digestion in Germany and at Decatur, Ill., referring particularly to the explosion hazard in the collection of such gases where the precaution of having the gas hood below the water surface is not rigidly followed; and to experience with aero-filters and the use of chlorine for odors and fly prevention.

Over 17 pp. are added to the discussion of the activated-sludge process. Part of this addition is taken up with an interesting review of the relationship between the various aeration processes. The additions to the activated-sludge chapter are especially interesting for the author's pithy references to patent controversies in the activated-sludge plants, to debatable hypotheses regarding the process, to pre-treatment of sewage, aeration tanks, particularly those used in the Ruhr District, secondary clarification, the developments in partial purification by activated sludge and to the problem of power costs for different forms of aeration mechanisms.

On the subject of operation and cost the author adds a new section on comparative costs, together with a graphic presentation of the cost situation which is quite

suggestive. In this discussion he sets forth the unit costs per capita for various processes of sewage treatment, in relation to the degree of purification accomplished by each method.

The book should have a wide distribution. It is written in the characteristically brief and authoritative style of Dr. Imhoff. Aside from its brevity, it has the attraction of having reduced to a minimum extraneous material, without affecting the usefulness of the large amount of valuable information in a very limited space. Differences of opinion regarding the judgments expressed by the author may arise, but this is to be expected in any text dealing with some matters still in a controversial stage.

Concrete Formwork

DESIGN AND CONSTRUCTION OF FORMWORK FOR CONCRETE STRUCTURES—By A. E. Wynn, B.Sc., A.M.Am.Soc. C.E. London: Concrete Publications Ltd. Cloth; 5x8 in.; pp. 296; 219 halftones and line cuts. 20s. net.

Stressing the importance of employing rational methods in designing forms for concrete construction, the author devotes 50 pages or about a sixth of his book to the mathematical discussion of loads and stresses and of the methods of choosing the correct timber sizes and spacing. The treatment appears ample in detail to meet the necessity of ordinary form designing which as it exists today has in a major degree grown out of experience and experiment and which will in large part continue to be empirical because of the number of problems other than statics which practical form design involves. However, the statics are here, as they certainly should be in a general treatise on form structure and construction, however much or little opinions may vary as to the need for their use. The 16 remaining chapters, illustrating and describing practical details of form framing, assembling, erecting, and removing, are in any event of unquestionable value for their scores of drawings and descriptions of selected examples of form construction and largely of American form construction.

In the three major chapters on form design, theoretical design is presented, first discussions of vertical loads, bending, shear, deflection, etc., with specific treatment of column forms, wall forms, posts, outside wall form braces, bolts and washers. Then comes a chapter of eleven design tables based on the formulas of the preceding chapter and covering sheathing sizes for slabs, walls and columns, sizes of joists, wales, yokes and posts, and sizes and spacing of wall ties. The third chapter explains design calculations by working out examples, beginning with simple slabs and working through more complex structural members to special members like stairs.

The chapters on detail construction of forms begin with seven on building forms, first footings, then columns, walls, beam and girder floors, rib floors and fireproofing steel, special forms as stair forms and flat slab floor forms. There are 80 illustrations in these chapters, largely line drawings of form framing and detailing. Chapters follow on forms for conduits, sewers and culverts; tanks, bins, standpipes; dams, piers and heavy walls, and arch bridges. There are two chapters on steel forms, (a) for building and wall construction, and (b) for curved surfaces. A chapter on patent devices as chairs, clamps and shores, and an essential chapter on planning form work, concludes the list of 21 chapters. There is a general index and an index to illustrations, of which there are 219 numbered.

Highway Administration

HIGHWAY ADMINISTRATION AND FINANCE—By Thomas H. Agg, C.E., Professor of Highway Engineering, and John F. Brindley, Ph.D., Professor of Economics, both of Iowa State College, Ames, Iowa. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 382. $4.

Highway construction at state, federal, and local expense is now a major governmental activity. Numerous books on highway design and construction have been written. The book now before us is the first text and reference work devoted exclusively to the administration and financing of highway work. Broadly, the book may be divided into two parts. The first treats the historical and financial aspects of the subject, and the second takes up engineering administration, the civil service and the economies of highway transportation.

The book opens with an admirable review of national highway construction, the chief part of which was the Cumberland Road. Here also constitutional questions are reviewed, as well as the early struggles between the advocates of centralization and state control, the latter including efforts to dictate routes. After several chapters on state and local highway development there is a similar but shorter review of like developments in Canada, England, France, and other countries. A chapter on the principles of highway finance introduces federal aid, banks and special assessments.

The last eight chapters take up highway engineering administration. These chapters outline the technical functions of highway departments; the special problems and activities of municipal highway departments; the organization and administration of construction; contract and day-labor construction; formal instructions and reports, and two discussions of general professional character on the field of highway engineering and on civil service in the highway field. However little or much the public roads official may glean from the discussion of specific engineering administration practices, he will do well to read the two concluding chapters, and that on contract and day-labor construction. All that is said may not meet his full agreement, but he will get from the whole a lesson in the fundamentals of his public obligations and an inspiration for this work which is of far higher value than any specific thing he may learn of construction economics or of inspection practice.

The book deserves wide use both as a college text and by engineers and all others concerned with highway administration and finance.

Cotton Spinning and Industrial Papers

MISCELLANEOUS SCIENTIFIC PAPERS of F. P. Sheldon & Son (Providence, R. I.), pertaining to Cotton Spinning and Industrial Engineering—Cloth; 8x11 in.; pp. 114; many halftones and drawings; charts and tables. $5 from above firm, F. P. Sheldon & Son, Providence, R. I.

Besides a half-dozen specialized papers like the opening one, entitled "Some Tests to Determine the Effect of Humidity, Ring Size and Spindle Speed, on the Strength of Yarn, Spun with Both a Stationary and Movable Thread Board," this volume contains seven of more interest to engineers generally, all relating to window and roof design. These take up heat transmission through various types of sash, roof and side wall lighting, under-surface condensation on various types of roofs, saw-tooth roof design and protection of wood roof from decay. Most of the papers have heretofore been scattered through the proceedings of textile and other technical societies.

Utility Rates and Rate Bases

GUIDING PRINCIPLES OF PUBLIC SERVICE REGULATION —By Henry C. Spurr, Editor of *Public Utility Reports*, Vol. III. Rochester, N. Y.: Public Utility Reports, Inc. Cloth; 6x9 in.; pp. 919 + 184-p. list of cases cited. $7.50.

More than half of the third volume of Mr. Spurr's digest of commission rulings and court decisions on public utility matters is devoted specifically to rates and much of the rest of the volume deals with closely related matters. The first two sections take up returns to which capital is entitled. Then come chapters on attraction of capital, efficiency of management and service, and other phases of return. Cost basis is next considered. Rates in general are then taken up, under flat and meter rates; minimum, service, meter and demand charges; large quantity charges; rate schedules and rates fixed by contract. After these topics and a general discussion of factors to be considered in rate making have been disposed of, some 360 pp. are given up to rates for the various classes of utilities—water, gas, electric and others.

As a rule, the method followed is to cite a number of rulings on a given topic and attempt no summary. There is no clear-cut separation between commission rulings and court decisions and no relative weightings of the various citations. As usual in such digests, dates of the rulings are omitted. All these things may not matter much to the lawyer, but from the viewpoint of engineers and other possible users they make a valuable digest less valuable than it might be.

Relation Between Immigration and Industry

MIGRATION AND BUSINESS CYCLES—By Harry Jerome, of the Staff of the National Bureau of Economic Research. With a Foreword by Wesley C. Mitchell. New York: National Bureau of Economic Research. Cloth; 6x9 in.; pp. 256. $3.50.

Those interested in migration will welcome this volume which is a part of a comprehensive study of the whole subject. The present work, "Migration and Business Cycles," according to the foreword by Dr. Mitchell, is a "part of two series of studies." The first of this series, "planned by the Committee on Scientific Problems of Human Migration, deals with the character, causes, and effects of mass movements of men," while the second of the series, which is planned by the National Bureau of Economic Research, deals with the character, causes and effects of cyclical fluctuations in economic activities. The present volume is a worthy addition to two earlier ones published by the National Bureau of Economic Research: "Business Cycles and Unemployment" and "Employment, Hours, and Earnings in Prosperity and Depression" (the latter now out of print).

After a general statement of "the problem" the author of the book under consideration takes up some of the significant features of migration, and of employment opportunities offered to immigrants, then considers immigration and business cycles prior to 1890, the pre-war period from 1890 to 1914 and the war and post-war periods. There are also chapters on cyclical fluctuations of selected elements in migration, on the influence of economic conditions in the countries of emigration and on seasonal fluctuation. A number of charts and tables deal among other things with cycles in economic conditions, imports of men and merchandise, factory employment and pig iron production.

The following sentences from the concluding summary will indicate the net results of the study:

In brief, whatever may be the basic causes of migration, there is a close relation between the cyclical oscillations of employment and those of immigration and emigration, and a moderately close resemblance in the respective seasonal fluctuations, with considerable reason to believe that this similarity, particularly in the cyclical oscillations, is due to a sensitiveness of migration to employment conditions.

However, after the introduction of the quota principle of restriction, with provisions which tend to modify the seasonal movement in immigration, it would appear that although the flow of immigrants is reduced in volume its distribution by months is now less likely than formerly to be well adjusted to the seasonal variations in employment.

. . .

As to cyclical fluctuations in unemployment, it would appear that, directly at least, migration is probably not a primary cause of such variations in unemployment; and that in some instances it is an ameliorative influence, in that in limited portions of depression periods it is withdrawing more workers than it is contributing. More frequently, however, it is a contributory factor to the evils of unemployment. . . . Also, although a decline in employment is usually followed by a decline in immigration, the incoming stream does not dry up entirely, and in those portions of depression periods in which there is a net immigration—a not uncommon phenomenon—migration is feeding into industry more men than it is taking out. Lastly, the very fact of a known source of additional labor available through increased immigration in boom periods probably has lessened the pressure for regularization of industry.

Publications Received

STATE REGULATION OF MOTOR VEHICLES is summarized in three pamphlets published by the Motor Vehicle Conference Committee, 366 Madison Ave., New York City.

THE RELATIVE IMPORTANCE of river and land traffic at Milwaukee, Wis., is the subject of a report by the local Board of Harbor Commissioners, entitled "Commerce on the Milwaukee River." The report includes a survey made by J. A. B. Tompkins and J. A. B. Tompkins, Jr., engineers.

THE PUBLISHERS of Flinn, Weston & Bogert's "Water-Works Handbook," which is reviewed by C. M. Saville on p. 122 of this section for January 20, 1927, were inadvertently omitted. Like the earlier editions, the latest one is published by the McGraw-Hill Book Co., New York City.

TAX RATES of 215 large cities of the United States for the year 1926, with adjustments to bring them to a comparable basis, have been reprinted from *The National Municipal Review*, December, 1926. Like tabulations for the four previous years, these were made by C. E. Rightor, of the Detroit Bureau of Municipal Research.

PROF. GEORGE F. SWAIN'S RECENT PAPER on "Why I Prefer Steel to Reinforced Concrete," together with a somewhat extensive discussion participated in by 15 engineers, fills up the larger part (66 pp.) of the January issue of the *Journal* of the Boston Society of Civil Engineers. It is expected that further discussion will appear in the March issue of the *Journal* (50c. per issue from the Boston Society of Civil Engineers, Tremont Temple, Boston, Mass.)

ANOTHER ANGLE OF THE DISCUSSION on the Great Lakes-to-Ocean waterways is given by a report of the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce, entitled "Great Lakes-to-Ocean Waterways, Some Economic Aspects of the Great Lakes-St. Lawrence, Lakes-to-Hudson, and All-American Waterway Project." A short abstract of this report was given in our issue of Feb. 3, p. 208. (25c. from Superintendent of Documents, Washington, D. C.)

FROM SHEEP PASTURE TO SKYSCRAPER is the title of a handsomely made booklet written by Reginald Pelham Bolton in honor of the 38-story building erected by the Equitable Trust Co. (New York City) to replace the Mills Building "which, when completed in 1881, was one of the monumental structures of the city." The booklet is given up largely to a description of Exchange Place, laid out in 1660

as Tuyn St. and later known as Garden St. Among the illustrations are two etchings by Anton Schutz, M.E. Other illustrations reproduce prints of old-time buildings.

WINTER TRACKWORK AND UNIFORM FORCES, to permit an all-year distribution of railway maintenance, is a leading subject in the 1926 "Proceedings" of the Roadmasters and Maintenance-of-Way Association ($1, from T. F. Donahoe, secretary, 428 Mansion St., Pittsburgh, Pa.). Other subjects of engineering interest are: "The Effect of Locomotives on Length of Turnouts," "Design and Maintenance of Rail Joints," "The Selection of Ties," "The Construction of Track Crossings," and "Cost Data for Maintenance-of-Way Work."

GIANT POWER IN PENNSYLVANIA is the subject of a report by the Giant Power Board to the Governor of Pennsylvania dated Dec. 7, 1926. The board was created by the Governor "to set the [giant power] problem in a clear light before the people and to co-ordinate toward its partial solution all the executive administrative authority given by existing law." The report is a general review of the giant power situation in Pennsylvania with details of the acts affecting the subject and allied matters. Accompanying the report is a large map showing in colors the territory served by the large holding companies in Pennsylvania, New York and New Jersey.

A BULLETIN OF MORE THAN ORDINARY INTEREST to those concerned with storage reservoirs for power and water-supply projects is No. 1430, August, 1926, of the United States Department of Agriculture, entitled "Financial Limitations in the Employment of Forest Covers in Protecting Reservoirs." The pamphlet deals with the possibilities of storage of storm water for power, permanency of power reservoirs, influence of forest protection on silting, and the relative value of forest and other cover for reducing silting, cost and value of reduction in erosion through forest planting, planting forests, settling basins, and the regimen and turbidity of the main stream systems in the United States. (15c. from Superintendent of Documents, Washington, D. C.)

ONE HUNDRED AND ELEVEN YEARS AGO the York Water Co. was chartered by the Pennsylvania Legislature. The history of the company, and of the York Suburban Water Co., chartered in 1906, is summarized in an illustrated pamphlet published by the first-named company (York, Pa.). Among other features of the main works are a filtration plant and reforested areas on which 630,000 evergreens have been planted. An excusable error in the pamphlet is a statement that the York works "is the oldest privately owned plant in Pennsylvania." Until recently this was commonly supposed to be the case, but a few years ago the Pennsylvania Water Supply Commission brought out the fact that the Schaefferstown Water Co. dates from "about 1732." Edgar P. Kable is general manager of the York Water Co.

AFTER SIX YEARS' INVESTIGATION a Summary Report on the Water Resources of California and a Co-ordinated Plan for their development has been submitted to the California Legislature of 1927 by Paul Bailey, state engineer (Sacramento). The plan has been worked out with the aid of a committee of nine advisory engineers and a large engineering staff. Its main features are thus summarized in the report: "This plan provides for the storage of flood waters for conservation purposes, the transportation of surplus waters of the Sacramento drainage basin to the deficient areas in the San Joaquin Valley, an adequate summer flow in the Sacramento River for navigation and salt water control, the resumption of hydraulic mining in the Sierra Nevada Mountains, the control of floods by reservoirs, the expansion of irrigation along the lower Colorado River in southeastern California, and the diversion of water from that river to the Pacific slope for municipal purposes."

REVIVAL OF DISCUSSION IN EUROPE of the Danube-Aegean waterway project has inspired the daughter of the Prince Lazarovich-Hrebelianovich to republish the paper which the latter presented before the American Society of Civil Engineers in 1920. Besides maps, profiles correspondence and other matter directly connected with the project the pamphlet contains miscellaneous correspondence, reprints and extracts which apparently are unrelated to the subject as they deal mostly with political conditions in the Balkans and with the War, largely records of the views of Prince Lazarovich-Hrebelianovich upon the War and the Balkan situation. (Unionist-Gazette Association, Somerville, N. J.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

CEMENT, CONCRETE AND BRICKS—By Alfred B. Searle, Lecturer on Brickmaking under the Cantor Bequest; Consulting Expert in the Cement and Clay Products Industries; Author of "British Clays, Shales and Sands," "The Natural History of Clay," "Modern Brickmaking," "The Clayworker's Handbook"; Joint Author of "Reinforced Concrete," Etc. Second edition. (Outlines of Industrial Chemistry Series.) New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 441; 115 line cuts and halftones. $6.

A second edition of an English book. Typical complete text, ranging from the chemistry of cement and clay to the practical production of concrete and brickwork. Practice described is nearly all British.

THE CONCRETE YEAR BOOK 1927: A Handbook, Directory and Catalogue for the Concrete Industry—Edited by Oscar Faber, O.B.E., D. Sc., M. Inst., C. E.; and H. L. Childe, Editor, Concrete Publications Limited. London: Concrete Publications, Ltd. Cloth; 5x8 in.; pp. 439; halftones and line cuts. Postpaid, 3 sh.

Lists all of the firms doing business in Great Britain in material and equipment dealing with concrete, prefaced by a review of the technology of concrete.

ECONOMICS: PRINCIPLES AND PROBLEMS—By Llonel D. Edie, Professor of Economics, Indiana University. New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp. 799; $5.

FORMLER FÖR BERÄKNING AV MEDELHASTUGHETEN I ÖPPNA—Av Lojnant Erik Lindquist. Stockholm, Sweden: Stockholms Bokindustri, A. B. Paper; 7x10 in.; pp. 47; line cuts and 5 plates of tabulated data.

A study in Swedish of the Ganguillet-Kutter and other formulas for the computation of mean velocities in open channels; a "separate" from the 1926 volume of proceedings of the Road and Water Development Society.

GROUND-WATER PROBLEMS OF THE BARRIER BEACHES OF NEW JERSEY—By David G. Thompson. [Bulletin of the Geological Society of America (Columbia University, New York City), Vol. 37, pp. 463-474, September 30, 1926.] Paper; 7x10 in.; pp. 14.

HYDRO-ELECTRIC HANDBOOK—By William P. Creager, Vice-President and Chief Engineer, The Power Corporation of New York, and Joel D. Justin, C.E., M.Am.Soc.C.E., Hydraulic Engineer, The U. G. I. Contracting Co., Philadelphia, Pa.; With the assistance of nine contributors. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 897; 494 halftones and line cuts; 93 tables. $8.

STATISCHE PROBLEME DES TUNNEL- UND DRUCKSTOLLENBAUES UND IHRE GEGENSEITIGEN BEIZIEHUGEN: Gleichgewichtsverhältnisse im massiven und kreisförmig durchörterten Gebirge und deren Folgeerscheinungen. Spannungsverhältnisse unterirdischer Gewölbebauten—By Dr. sc. techn. Hanns Schmid, Ingenieur E.T.H., Chur. Berlin: Julius Springer. Paper; 6x9 in.; pp. 148; 36 line cuts. 8.4 reichmarks in Germany.

An analysis of the deformations and resulting stresses around a rock tunnel, basing on the mathematical theory of elasticity and taking account of the factors influencing the elastic constants of the materials. The author considers separately the application of his formulas to the unlined heading itself and to the tunnel lining. The results are conceded to have only broadly qualitative value, and even this only in so far as they agree with experience.

THEORIE DES CHAMBERS D'EQUILIBRE: Etude du Mouvement Varié de l'Eau dans les Conduites sous Pression Munies d'un Réservoir a Libre Expansion; Suivie de Renseignements Complementaires pour le Calcul des Chambres d'Equilibre—Par Jules Calame, Ingénieur, Diplomé de l'Ecole Polytechnique Fédérale, Licencié des Sciences Commerciales; et Daniel Gaden, Ingénieur, Diplomé de l'Ecole d'Ingénieurs de Lausanne; Avec Préface de René Neeser, Ancien Professeur de Machines Hydrauliques a l'Université de Lausanne, Directeur des Ateliers des Charmilles, S. A., Genéve. Lausanne (France); Editions la Concorde, Jumelles 4; Paris: Editions Gauthier-Villars, 55 Quai des Grands-Augustins. Broché (paper) or Relié (cloth bound); 7x10 in.; pp. 271; 50 line drawings, 15 being inserts. Paper, 17, bound, 20 Swiss francs.

VENTILATION AND HEALTH: The New Hygiene of Fresh Air—By Thomas D. Wood, A.M., M.D., Professor of Physical Education and Advisor in Health Education, Teachers' College, Columbia University, and Ethel M. Hendriksen, former Executive Secretary, Tuberculosis and Public Health Association of Rochester and Monroe County, New York. New York and London: D. Appleton & Co. Cloth; 5x7 in.; pp. 210; numerous line cuts and halftones. $2.

A popular exposition of the newer scientific ideas on ventilation, in which the use of windows plays a large and sometimes the only part. Concluding chapter deals with educational methods of promoting knowledge and practice of ventilation.

WATER POWER ENGINEERING—By H. K. Barrows, S.B., M.Am.Soc.C.E., M.Am.Inst.C.E., Professor of Hydraulic Engineering, Massachusetts Institute of Technology, Consulting Hydraulic Engineer. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 734; 306 halftones and line cuts. $6.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

A Word in Protest Against a Federal Department of Public Works

Sir—I have read with a great deal of interest the outline for the proposed "Department of Public Works" contained in *Engineering News-Record*, Jan. 27, 1927, p. 154.

Under existing conditions if the "Secretary and Directing Engineer of Public Works and Domain" was appointed as a cabinet minister the public works of this nation would certainly be under venal political control. If he arrived through the operation of the civil service law, interests that would be benefited by such a department would feed their men into the civil service mill and when these men came by the operation of seniority into power these interests would control the proposed department.

Fortunately the Corps of Engineers has avoided these evils. It is a body of men that cherish the ideals of Washington and Lee. Would it not be better to preserve such a valuable organization rather than destroy it by merging it with conglomeration of political organizations who have heretofore suffered excessively from the evils of partisan politics? Why not attempt to cure defects that may exist in the Corps of Engineers rather than unite this brilliant branch of our government with other units whose management has been far from satisfactory? S. B. MOORE,

Temple, Texas, Feb. 1, 1927. Consulting Engineer on Research, Texas Highway Commission.

Special Assessments for Paving and Other Public Improvements

Sir—I was much interested in the decision of the U. S. Court of Appeals, District of Columbia, upsetting frontage assessment repaving work in Washington and in the accompanying editorial in your issue of Jan. 6, 1926, pp. 20 and 3. I agree with you that the foot-front rule of assessment for municipal improvements is totally irrational and with your further conclusion that under modern traffic conditions we must more and more depart from the custom of assessing the entire cost of a pavement on abutting property and make some portion of the cost a general tax upon the community benefited.

There seems to be no other rational way of assessing costs of the improvement of our highways than establishing in each case the benefits arising to each particular property by reason of the improvement. In other words, a comparison should be made between the "value of the property before the improvement and its value after the improvement and as affected thereby," and this should, with reasonable limitations, be considered the amount the abutting property should pay for the improvement.

Why should this not be the rule, not only in the cities and boroughs of a state, but in the outlying lands situated in townships and even in the most remote districts? Why should any road be constructed anywhere without a portion of its cost being assessed upon abutting property? Exceptional conditions may arise whereby a property is not benefited in the least degree by reason of the improvement of the road upon which it abuts, but such conditions are rare.

The intelligent apportionment of road cost should furnish a fertile subject for discussion by engineers. In the recent report of the retiring governor of Pennsylvania, the statement was made that over $300,000,000 was spent in a four-year term in the improvement of highways under the State Highway Department. Such a rate of expenditure of money, it seems to the writer, cannot continue indefinitely if the source of income is limited entirely to general revenue, bond issues, and gasoline tax. But if the principle were established that a proportion of the cost of the improvement of main state highways, and all other highways improved by the state, were borne by abutting property and by communities particularly benefited by said improvement, the state highway and county highway programs could be extended in a rational manner more nearly to meet the need of the traveling public. It seems to the writer that there are very few cases in which the entire cost of paving in front of a property should be borne by abutting property owners, and there are equally few cases where the general public should pay the entire cost of paving, and thus entirely relieve abutting property from assessment.

Why should not the same principle of local benefits be adopted by the United States government in its improvements? In your issue of Jan. 20 you advocate that the beneficiaries of the Boulder Canyon irrigation project should be required to pay interest and principal on the construction cost of the project. Possibly this is going too far in the direction of assessment, but surely some portion of it should be paid by those directly benefited. And if this is true, is it not equally true that when a river is improved by the United States Government by the construction of expensive locks and dams, and properties which were previously unavailable for manufacturing purposes due to lack of transportation are brought into the market by reason of such slack watering, such property should pay at least a small part of the cost of such river improvement upon the basis of frontage or acreage assessment? Possibly there would be less pressure brought to bear upon Congress to improve our rivers and to build expensive irrigation and other works if it were known that a portion of the cost must be borne by those directly benefited.

Pittsburgh, Pa. Feb. 4, 1927. LOUIS P. BLUM, Civil and Mining Engineer.

[As we have often stated, the underlying principle of special assessments is that they shall be levied in accordance with special benefits to individual property owners. The practice is too often the use of arbitrary methods of apportioning benefit sometimes established in advance by legislative fiat instead of determined in a judicial or quasi-judicial way for each improvement. In earlier days, in the relatively few states that built highways or helped counties do so, substantial portions of the cost of rural highway improvements were assessed on abutting or relatively nearby property. Apparently this practice has tended to grow less with the vast highway building programs and bond issues of recent years. The federal government has no direct power to levy local special assessments or to compel states to do so; indirectly it might at least encourage individual states to do this in the case of federal aid or other co-operative agreements. The entire cost of the irrigation works built under the U. S. Reclamation Service (now Bureau of Reclamation) was supposed to be borne on an acre-unit basis by the land irrigated, but because much of the land was public owned and because the United States supplied the money and did the work, the governing conditions were peculiar. The same general condition would pertain and presumably would be applied in the case of the Boulder Canyon project for municipal water supply, irrigation, flood prevention and power.—EDITOR.]

Testing Sand for Concrete Aggregate

Sir—The present methods of testing sands for use in concrete aggregate often eliminate a sand which in reality is perfectly good for use in any class of concrete work, and often local sands are discarded in favor of foreign sands brought in at a much greater cost and some inconvenience.

One of the standard tests of the American Society for Testing Materials is that the sand must be equal or superior to standard Ottawa sand in the tension test of 1:3 mortar briquettes, and the amount of water to be used in making this test is standardized by use of the Vicat needle.

The writer was recently given a local sand to test and he found that it gave only 82.1 per cent of the tension strength of the standard sand mortar, using a water-cement ratio (by volume) of 0.636 for both sands. The water-cement ratio was then increased in the local sand mortar to 0.845 and the tension strength increased to 98.5 per cent that of the standard sand mortar. The local sand was very fine and its fineness modulus (Abrams' theory) was only 2.63 and as the fineness modulus of the standard Ottawa sand is 3.0, it was decided to sieve out some of the finer parts of the local sand in order to make its fineness modulus equal to or greater than that of the standard Ottawa sand. After screening, the fineness modulus was 3.13. Standard

1: 3 briquettes were made with this latter sand and the consistency (0.785 water-cement ratio) was made the same as in the standard sand mortar. These briquettes averaged 113.5 per cent of the tension strength of the standard sand mortar, and conclusively proved that the sand was structurally sound.

A compression test was made using a 1: 5 nominal mix, combining the local sand with a crushed rock aggregate (ranging in size from ¼ to 1½ in., whose fineness modulus was 7.3) in the ratio of 31 per cent sand and 69 per cent coarse aggregate, to give a combined fineness modulus of 5.84, and a slump of 1½ in. The average compression strength of these cylinders was 3,460 lb. per sq. in. at 28 days.

Other investigations have verified the above data which show that the standard tests used in the past do not always give reliable data upon which to pass judgment on all sands.

In testing a sand for concrete aggregate, the conclusions from the above are:

(a) The local sand mortar should be of the same consistency as the standard Ottawa sand mortar for tension test.

(b) Make the fineness modulus of the local sand equal to or greater than that of the Ottawa sand as one part of the test for tension.

(c) Combine the local sand in the proper proportion with the coarse aggregate with which it is to be used, and make a compression test in the standard 6 to 12 in. cylinders.

Tucson, Ariz. RICHARD BENNETT.
Jan. 6, 1927.

Cost of American Falls Dam

Sir—On page 63 of your Jan. 13 issue mention is made of the American Falls Dam across Snake River at American Falls, Idaho, and the statement is made that "Cost will be about $1,600,000." While this statement is probably technically true it is very apt to be quite misleading. The actual cost of the dam itself will be about the amount stated but the cost of the reservoir will be about $8,000,000 or the storage created will cost about $5 per acre-ft. This large difference between cost of the dam and of the reservoir is due to expensive right-of-way, necessity of moving a whole town, settlement with power company for water rights, etc. This is rather out of the ordinary to find a situation where the actual cost of the dam itself is such a small proportion of the total cost of creating storage and it is for this reason that your statement is apt to be misleading.

LESTER C. WALKER,
Aberdeen, Idaho, General Manager, Aberdeen-
Jan. 19, 1927. Springfield Canal Co.

Not Sufficient Time for Discussion

Sir—On p. 855 of *Engineering News-Record* for Nov. 25, 1926, you have an editorial entitled "Crowded Programs." Unfortunately, I am one of the members of the American Society of Civil Engineers who can attend but one meeting in three years, and that at considerable expense and long distance travel, as it is approximately ten thousand miles from Manila to New York.

I make it a point, however, whenever I am in the United States to attend a meeting of the society wherever it may happen to be, and I always enjoy the meetings, probably fully as much as the more fortunate permanent residents of the United States.

I attended the Philadelphia meeting, and had a very good time, so I have no kick coming. However I was particularly interested in one phase of one of the sections, and wanted to talk it over at the particular session in question. As I am not particularly bashful and as I don't very often get a chance to talk in meeting among my friends, I got up at the end of the reading of the paper to ask something, and was informed by the chairman that all the discussions were prearranged and that though he was sorry yet he was afraid there would be no time available, and so I had to subside.

The above is not intended as any criticism, as doubtless you cannot arrange a meeting to please every one.

A. GIDEON,
Manila, P. I., Manager, Metropolitan Water District,
Dec. 28, 1926. Government of Philippine Islands.

Concrete Imperfectly Manufactured

Sir—I note with considerable interest your editorial of Dec. 23 concerning Professor Swain's paper, "Why I Prefer Steel to Reinforced Concrete," and think that you are most decidedly wrong in your interpretation of this paper. You evidently did not read the article with an open mind.

In my reading of the article I did not get the impression that it was an "indictment of reinforced concrete" or a "militant review." Reinforced concrete has been, and is, "variable, undependable, non-permanent and changing during life," but this is no indictment of the material but rather an indictment of the method of manufacture. What I assume that Professor Swain would like to see accomplished is to have reinforced concrete manufactured with the same degree of skill and care that is used in the manufacture of steel or other structural materials.

Every step in the manufacture of steel is performed under conditions most favorable for the producing of a material of homogenous, reliable and assured quality. There is no guesswork about the finished product, and every step is controlled by men of experience and education. After a structure has been properly designed of steel by a competent engineer or architect there is very little chance but that the material will be erected in a proper manner, under proper inspection. On the other hand think of the way reinforced concrete is built into most of our structures today. It has always been one of the seven wonders to me why engineers and architects will so carefully design the members of a structure and then permit the members to be built by men whom a contractor (a very responsible contractor no doubt), whose profits depend upon the number of batches of concrete that can be turned out in a given time, can hire for 30c. per hour.

When reinforced concrete is made by a force of skilled men who know how to select the proper materials, how to mix them in the right proportions with exactly the right amount of water, and who can control such mixture from the time it is mixed until it takes its final set, then Professor Swain, and others, will offer no argument.

The point is that reinforced concrete requires exactly as much skill in manufacture as steel but, under present conditions, it gets far, far less. We should all endeavor to bring about conditions that will require nothing but the proper manufacture of reinforced concrete.

ELWIN QUINNEY.
(A tax-payer in the state of South Dakota, which owns and operates, profitably, a modern cement plant of which we are justly proud.)
Watertown, S. D.
Dec. 30, 1926.

"Sold—for $3.25"

Sir—To me, there is always a spell of romance about an old surveying instrument, so chancing to notice in a local paper a few days ago the advertisement of an auction sale of household goods, among which was the item "Surveying Outfit," I attended the sale out of pure curiosity.

The "Surveying Outfit" proved to be a very old compass with its tripod. The instrument was of a make and type not to be purchased today and appeared to be fifty years old or more. It was of brass and was fitted with a small, detachable telescope mounted on single-brace standards directly over the plate. All was in wood box and the box was contained in heavy leather case with shoulder strap, much worn. The needle being of an improved design, I judged it was not the one with which the compass had been originally provided.

Had the old instrument been the product of one of the great makers, I would have wanted to possess it as an antique, but having been made by some obscure and almost nameless manufacturer who never made a reputation and no longer exists, I considered it almost without value. Those present, interested enough to bid must have thought the same. The bidding began at fifty cents and the old hero of many a desert and mountain line fell under the hammer at $3.25. This was, after all, perhaps as much as it is now worth. It should receive an "honorable discharge" from the service, having outlived its usefulness.

Albuquerque, N. Mex. W. TALMA CRAWFORD,
Feb. 3, 1927 Civil Engineer

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Concrete Institute to Hold Convention Feb. 22-24

The American Concrete Institute will hold its twenty-third annual convention at the Palmer House, Chicago, Feb. 22-24. Of particular interest among the papers to be read are one on the construction of the Bremerton pier by Lieut. Commander J. J. Manning, the control of concrete on the Wacker Drive, Chicago, by Arthur R. Lord; the design and construction of the Grandfey viaduct by Adolph Buhler, chief engineer of bridges, Switzerland Federal Rys.; "Hurricanes vs. Concrete," a discussion of observation in Florida and Cuba: "Design of Concrete Buildings for Wind Stresses," by Albert Smith; "The Reinforced-Concrete Column," by Phil J. Markmann; "Reinforced-Concrete Structures in Japanese Earthquake"; a group of papers on the manufacture of concrete products and another on aggregates.

Also of special interest in the convention is an architectural session at which papers will be presented by Frederick Lee Ackerman, New York; John C. Austin, Los Angeles and Irving K. Pond, Chicago, each one of which will discuss the architect's approach to the subject of concrete as an architectural medium. There will also be a paper by Dr. R. H. Bogue of the Portland Cement Association fellowship of the Bureau of Standards, describing that bureau's investigation of cement.

Several important committee reports will be read. They include curing tests on concrete products, standard concrete building units, aggregates, research, economics of field control of concrete mixtures and formwork for building construction. Tentative specifications for concrete curb and concrete curb and gutter will be presented, as will tentative building regulations for the use of reinforced concrete.

At the closing session the Wason Medal will be presented to A. Burton Cohen, New York, for the most meritorious paper presented to the 1926 convention: "Correlated Considerations in the Design and Construction of Concrete Bridges."

President of Great Northern Outlines Unification Plan

A great railway system in the Northwest will be established if the proposed unification (but not consolidation) of the Great Northern Ry., Northern Pacific Ry. and Spokane, Portland & Seattle Ry. is effected, under the control of a new company. This third line was built and is owned jointly by the other two, which also control the Burlington system. According to a statement to *Engineering News-Record* by Ralph Budd, president of the Great Northern Ry., these first three roads would be operated as a single carrier system, while the Chicago, Burlington & Quincy R.R. would be under the same control but operated separately. Important operating economies and advantages are anticipated from the operation of the three lines as a unit system, supplementing the advantages already effected by joint use of certain lines and terminals at various points. With all cars and locomotives under one authority it is urged that there would be better car service, more rapid movement of freight, reduction in terminal delays and more effective use of equipment. While the Great Northern and the Northern Pacific are competitive between many points, they are largely complementary, since 58 per cent of the former's mileage is on the eastern part of its line, while the latter has 60 per cent of its mileage on the western part of its line. In the combined system the proportions would be 49 per cent west and 51 per cent east.

Engineering Fifty Years Ago

From *Engineering News*
Feb. 17, 1877

A PETITION presented to the Common Council shows that there are 55,000 unemployed laborers in New York, and that their families number about 220,000 persons, who are reduced to great destitution. The Council has asked the Legislature to pass a law authorizing an appropriation of $1,000,000 for repairing the down-town streets now in bad condition, in order to provide these men with work. The relief societies are all overtaxed, and there has never been so much want in the city as at present.

Pioneer Heading of Moffat Tunnel Drilled Through Feb. 12

Early on Saturday, Feb. 12, the east and west headings of the pioneer heading (water tunnel) of the Moffat tunnel were connected by a 33-ft. drill steel at a point about 18,400 ft. in from the east portal and 14,000 ft. from the west portal. The final step is to be reserved for a formal celebration on Feb. 18, when the last 8-ft. wall of rock is to be blown down. President Coolidge will fire the round by telegraph and Governor Adams of Colorado and Governor Dern of Utah will then join hands at the center of the tunnel, 2,800 ft. below the Continental Divide.

Check of alignment, grades and distance shows very close survey results, the check being within a fraction of a foot in the 6.1-mile length of tunnel.

Western Maryland Will Build Baltimore Piers

The Port Development Commission of Baltimore has granted authority to the Western Maryland Ry. Co. to proceed with the preparation of plans and specifications for the construction of a pier and warehouses at the foot of McComas St., Baltimore. At the same time the body approved the employment of the J. E. Greiner Co., Baltimore, as consulting engineers in the construction of the pier and warehouses. James E. Greiner, the head of the concern, was formerly chairman of the Port Development Commission, but resigned recently. James H. Preston, former mayor of Baltimore and a member of the commission, has been appointed temporary chairman.

Bernard L. Crozier has been named chief engineer to the commission. Mr. Crozier will form a committee of engineers to have supervision over time, material and adherence to specifications during the construction of the pier and warehouses.

Ohio Engineering Society Holds Annual Meeting

A number of interesting papers and discussions featured the annual meeting of the Ohio Engineering Society, held at Columbus, Feb. 7-9. It was the forty-eighth annual convention and the attendance was the largest in the history of the organization, being close to 300. Papers on foundation work were features of the technical sessions. H. L. Bigelow, assistant engineer of construction of the Cleveland Union Terminals Co., Cleveland, described the construction of that building project and Prof. Clyde T. Morris, Ohio State University, followed with a discussion of foundation work on the American Insurance Union Building in Columbus.

Other papers included those by Prevost Hubbard, chemical engineer of the Asphalt Association, New York, on "Correlation of Stability Tests With the Behavior of Pavements Under Traffic"; C. E. Shafer, engineer of the Armco Culvert and Flume Manufacturers' Association, Middletown, Ohio, on "Results of Research into the Behavior of Pipe Culverts Under Loads"; V. R. Burton, engineer on special assignment, Michigan State Highway Department, Lansing, Mich., on "Technical Research Applied to the Problems of the Modern State Highway Department," and Walter Voigtlander, sales engineer of the American Cable Co., New York, "The Delaware River Suspension Bridge."

Officers elected for the coming year are: President, Curtis C. Lattimer, Columbus; first vice-president, F. W. Jennings, Columbus; second vice-president, Harry J. Kirk, Columbus, and secretary-treasurer, Carl L. Van Voorhis, Columbus.

Arkansas Assumes Obligations of Road Improvement Districts

Under a measure passed recently by the Arkansas Legislature and signed by the governor Feb. 4 the state pledges to pay $6,500,000 a year from its revenue derived from automobile, gasoline and motor oil taxes on the $50,000,000 road district bonds outstanding in the state. This sum will not only meet all the interest charges but provide an adequate sinking fund for the retirement of such bonds. The law also relieves land and real estate owners of about 50 per cent of their taxes and greatly enhances the value of all road district bonds.

In 1926 the state collected a total of $9,000,000 in automobile, gasoline and motor oil taxes and this sum is expected to increase considerably with the building of more good roads.

The new law is retroactive, dating from Jan. 1. In anticipation of its passage several road districts have refused to pay the interest due on their road bonds, claiming the state would assume the obligations and taxes derived from land and real estate and that they are not liable for road district charges.

The Arkansas State Highway Commission has about $3,500,000 on hand and as soon as necessary its office organization will begin paying the interest and maturities on road district bonds. All such outstanding claims will be settled by March 1 it is believed.

The law also provides for the issuance of not to exceed $13,000,000 in notes annually for the next four years for the construction of roads. These notes will not become due and payable until all of the present road district bonds have been paid.

Research Graduate Assistantships Open at Illinois

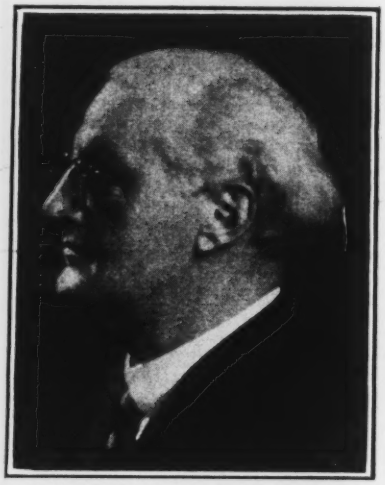
Appointments to the position of research graduate assistant are soon to be made by the executive staff of the Engineering Experiment Station at the University of Illinois. Applications for these nominations will be received by the director of the station not later than April 1, 1927. Nominations are based upon character, scholastic attainments and promise of success in the principal line of study or research to which the candidate proposes to devote himself.

Appointments are made in the spring and are effective the first day of the following September. The University of Illinois maintains 14 such assistantships. Two others have been established under the patronage of the Illinois Gas Association. For each there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees. Assistantships are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry.

Additional information may be obtained by addressing the director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Sumner Sollitt Elected President General Contractors

Sumner Sollitt, who was elected president of the Associated General Contractors of America at its recent meeting at Asheville, N. C., was born in Chicago, June 27, 1873. He was educated in the South Division High School in Chicago and has been in the building business continuously since 1888, when he was 15 years old. He



Sumner Sollitt

was associated with his brother, Ralph, until 1910 and is now president and treasurer of the Sumner Sollitt Co., 307 North Michigan Bldv., Chicago. He is also vice-president of the Building Construction Employers' Association of Chicago and ex-president of the Builders Association of Chicago. Mr. Sollitt has been active in the Associated General Contractors of America for some years. He is a member of various fraternal and social organizations in and around Chicago.

North Jersey Transit Commission Enlarges Upon Its Plans

The North Jersey Transit Commission, in a report to the Senate and General Assembly of the state of New Jersey, has outlined the further progress made upon its study of the suburban transit problem in that part of the metropolitan district of New York which comes within the state of New Jersey.

The plan for the relief of the suburban traffic situation prepared by this commission last year was reviewed in *Engineering News-Record*, Feb. 4, 1926, p. 205. The present report is an enlargement of that plan with adjustment to fit it to the changed plan for rapid transit on Manhattan Island, including the new 8th Ave. subway and the Fort Lee bridge. One of the principal features of this year's report is the detailed study of the possible methods of financing the construction of the proposed rapid-transit system and a study of the growth of northern New Jersey and the possibility of the effect of the new system upon future growth.

Iowa Engineers Adopt Service Specifications

The outstanding action of the recent annual meeting of the Iowa Engineering Society, held at Des Moines, was the adoption of standard forms of specifications to be used by engineers when entering into contracts with municipalities for professional service. These define the duties and responsibilities of the engineer and the method of payment of his fees. A form of agreement between the city and the engineer is included.

Professor O. R. Sweeney, Iowa State College, in a paper on "The Application of Engineering to Agricultural Wastes" said that the agricultural engineer is one who applies the various branches of engineering to farm problems, and that the engineer has a wide opportunity to assist the farmer in utilizing waste materials, especially in vegetable products. Thus furfural, a new liquid used in chemical work is now produced from corn cobs in large quantities. Along the same lines were papers on: "The Application of Engineering to Agriculture," Professor J. B. Davidson; "The Engineer in Manufacturing," G. B. Eastburn, industrial commissioner, Sioux City; "The Engineer in Research," R. W. Crum, State Highway Commission, and "The Engineer in Community Safety," by C. C. Williams, University of Iowa. Other papers included: "Oxygen Balance in Stream Pollution," by Samuel A. Greeley, Chicago, and "Erosion and Silting of Dredged Channels," by C. E. Ramser, U. S. Bureau of Public Roads.

Officers for 1927 were elected as follows: President, Monroe L. Patzig, Des Moines; vice president, Earle L. Waterman, Iowa City; secretary, John S. Dodds, Ames, Iowa.

Missouri Men Seek Tax-Refunding Plan for Reclamation Areas

A system of 12 federal investment banks, one for each federal farm-loan district, to aid the refunding of tax-burdened reclamation areas was proposed by the Black and St. Francis Rivers Commission following a two years' investigation of the problems of such districts. The commission was authorized by the Missouri legislature to formulate a definite program for refunding drainage operations in Missouri.

James A. Finch of New Madrid, Mo., was chairman of the commission. He said that Congress will be asked to enact the needed legislation to establish the investment banks and to appropriate $60,000,000 for the capital stock of the banks, which would be organized under the Farm Loan Act and under the Farm Loan Board.

The commission proposed that such banks be authorized to purchase or discount bonds issued by reclamation districts, issue their own obligations and spread payment of the drainage bonds over a long period of years.

The commission is composed of Mr. Finch, W. F. Shelton of Kennett, R. B. Hart of Caruthersville, John F. Wagner of Greenville and W. N. Barron of Poplar Bluff, Mo.

Chicago Regional Planners Report Year's Progress

Progress in regional planning in territory within 50 miles of Chicago was stressed at the fourth annual meeting, Jan. 26, of the Chicago Regional Planners in Chicago. Robert Kingery secretary, reported that through the efforts of the association six counties now require 100-ft. right-of-way dedications on main highways and section-line roads, also 80-ft. rights-of-way on half-section lines when land outside municipalities is subdivided. On this basis 180 miles of 100-ft. and 200 miles of 80-ft. roads have been acquired to date in this manner. Several municipalities are adopting the same regulations, thus providing without cost for the future wide road system.

The second outstanding accomplishment of the year was the engineering work of the staff in laying out the $32,000,000 connected system for Cook County regardless of political jurisdiction, allocating the cost to state, county, forest preserves, park boards and municipalities, and getting acceptance of each to its share of the system. In superhighways the association has located and is now helping acquire rights-of-way for the 200-ft. 150-mile Three-State Boulevard connecting Milwaukee, Chicago and Michigan City. Similarly it has assisted in locating 75 miles of 200-ft. radial superhighways to the west in DuPage County.

The association has become very active in water supply and sewage. A conduit code for the installation of water mains, sewers and other underground utilities, allocating the space below the street surface, has been drafted with practically all interests represented and accepting the provisions contained in the code.

The newly elected officers of the association are as follows: President, D. H. Burnham; treasurer, B. F. Affleck; and secretary, Robert Kingery.

Columbia Would Widen Usefulness of Engineering Training

President Nicholas Murray Butler of Columbia University has appointed a committee of alumni of the engineering schools "to study from the point of view of the practising engineers some of the present problems relative to engineering training and research and the duty and opportunity of Columbia University in regard to them."

Systematic instruction in engineering was begun at Columbia in 1863 when the School of Mines was established under the leadership of the late Professors Vinton, Egleston and Chandler. President Butler explains that modern social and industrial organization demands readjustments in engineering training.

The committee which will report to President Butler for his information and for the use of the appropriate University authorities is headed by Milton L. Cornell of the class of 1905. The other members announced are:

Daniel E. Moran, C.E., 1884, consulting engineer; Arthur S. Dwight, M.E., 1885, consulting engineer; Gano Dunn, E.E., 1891, president of the J. C. White Engineering Corporation; Francis Blossom, C.E., 1891, partner of Sanderson & Porter; Harris K. Masters, M.E., 1894, formerly president the Engineering Alumni Association; Henry C. Carpenter, E.E., 1899, general manager, New York Telephone Co.; Richard E. Dougherty, C.E., 1901, engineering assistant to the president of the New York Central Lines; Darwin S. Hudson, C.E., 1901, construction engineer, Consolidated Gas Co.; David M. Myers, M.E., 1901, consulting mechanical engineer; Elihu C. Church, C.E., 1904, consulting engineer; Milton L. Cornell, C.E., 1905, president of the Cornell Iron Works, Inc.; John J. Ryan, E.E., 1909, engineer, New York Edison Co.; Roy U. Wood, Met. E. 1914, assistant treasurer, Research Corporation; Frederick W. Jewett, Chem. E., 1918, consulting engineer; Stephen P. Burke, Chem E., 1920, director of Research Laboratory.

The committee, President Butler said, will make its study in consultation with the faculty of applied science, and with those trustees of the University who have been graduated in engineering. These include:

General William Barclay Parsons, C.E., 1882, member of the engineering firm of Parsons, Klapp, Brinckerhoff & Douglas; Walter H. Aldridge, E.M., 1887, president of the Texas Gulf Sulphur Co.; Frederick Coykendall, C.E., 1897, president of the Cornell Steamship Co.; H. Hobart Porter, E.M., 1886, president of the Brooklyn City R.R. Co., and member of the firm of Sanderson & Porter.

Chesapeake & Ohio Asks Control of Erie and Pere Marquette

The Chesapeake & Ohio Ry. Co. has applied to the Interstate Commerce Commission for authority to acquire control of the Erie and Pere Marquette railroads through stock ownership. Simultaneously, in a separate petition to the commission, the railroad asks approval of an issue of additional common stock of the C. & O. of a par value of $59,500,000 "for the enhancement of the capital structure, through substitution of stock for bonds, and for the purpose of reimbursing the company treasury for capital expenditures for additions and betterments."

These applications by the C. & O. constitute the first official step in reviving the scheme proposed to the commission two years ago for grouping the Nickel Plate, Pere Marquette, Erie, Chesapeake & Ohio, and Hocking Valley railroads into one system. The former petition was submitted by the Nickel Plate R.R. and was rejected last year because the Interstate Commerce Commission found some of its financial features to be not in the public interest.

Under the proposed new arrangement the Cheapeake & Ohio will acquire from the Nickel Plate Railroad Co. and from the Van Sweringen interests shares of the Erie and Pere Marquette, either owned or held under option, in addition to the shares which the Chesapeake & Ohio already owns.

Nothing is said in the application to the commission concerning including the Nickel Plate R.R. in the proposed new system.

Engineering Museum Trustees Elect Officers

The board of trustees of the National Museum of Engineering and Industry announces the election of new officers and a new program as the result of a recent meeting held in New York City. Up to this time efforts have been concentrated on a program to raise endowment funds. Hereafter they will be concentrated on holding together and increasing the membership until it is determined whether the fund-raising activities can be resumed with good augury. It was agreed that commendable progress had already been made, but that even so meritorious a movement as the establishing of a national museum of engineering and industry cannot succeed without the co-operation of the four founder societies.

The complete list of the new officers follows: President, Thomas Ewing; vice-presidents, Edward G. Acheson, L. H. Baekeland, Charles F. Brush, Thomas A. Edison, Frank J. Sprague, Edward Weston, Orville Wright; consulting secretary, H. F. J. Porter; secretary, Harrison W. Craver; treasurer, George E. Roberts.

A resolution expressing recognition of the interest and support of the retiring president, Samuel Insull, was unanimously adopted.

Packard Gives Lehigh $1,000,000 for Engineering Laboratory

A gift of $1,000,000 for the erection of an electrical and mechanical engineering laboratory at Lehigh University by James Ward Packard, a graduate of the class of 1884 and originator of the Packard automobile, was announced at a recent meeting of the board of trustees of Lehigh University. Aside from the stipulation that the new laboratory shall be the finest plant of its kind in existence, Mr. Packard's gift is unconditional. The new building will be known as the James Ward Packard Laboratory. This is the largest gift ever made to Lehigh University by a single individual since its establishment in 1865 by Asa Packer.

Preliminary plans for the James Ward Packard Laboratory have been prepared by Visscher & Burley, architects, of New York. It will have an overall width of 225 ft. and a depth of 184 ft., designed in the Collegiate Gothic style.

A.A.E. Would Fight Misleading Correspondence Schools

According to an announcement recently issued by H. A. Wagner, national director and chairman of the national correspondence school committee of the American Association of Engineers, that association has prepared a bill to curb misleading correspondence schools. This bill is now being introduced into various state legislatures and it is the intention of the A.A.E. to present it to Congress in order to obtain federal legislation on this subject. The bill seeks to eliminate fly-by-night correspondence schools by requiring the filing of an application for a certificate with each state department of education.

Washington Notes

THAT the disposition of the government's Muscle Shoals properties will have to go over until the next session of Congress now seems certain. The bidders already are maneuvering for positions of vantage before the Seventieth Congress, which will convene Dec. 6, 1927, unless called in extra session.

As this is written, the American Cyanamid Co., one of the bidders, seems chiefly concerned in preventing an unfavorable report on its offer. The subcommittee of the Military Affairs Committee of the House by a vote of 4 to 3 on Feb. 12 held that it cannot report favorably on that offer or that of the Farmers Fertilizer Corporation.

It now is being suggested by public officials that the government itself should experiment with nitrogen manufacture at Muscle Shoals and remove the uncertainty from future negotiations by demonstrating what can or cannot be done in the way of fertilizer production there. The power has a definite value. The Wilson dam, with a capacity of 610,000 hp., at 90 per cent efficiency and with a 75 per cent load factor will produce in the average year 2,280,000,000 kw.-hr. of energy. The proposed addition of 80,000 hp. to the steam plant would give that auxiliary a capacity of 120,000 hp. which would bring the total to 2,480,000,000 kw.-hr. of which 1,940,000,000 kw.-hr. would be primary power. This energy would be produced at an average cost of 1.75 mills per kw.-hr. or at a cost of 2.25 mills for the primary power alone. The primary power could be sold readily at 3.5 mills while 3 mills, 2 mills and 1 mill could be secured for the secondary power, government specialists estimate. This would mean that the power alone has a market value of $4,526,000 annually.

For these reasons it is argued that the government should establish the value of its nitrate plant when it would be in a position to negotiate intelligently for the sale of the project.

A NEW general bridge bill has been introduced in Congress, with special reference to control of toll bridges. The Secretary of War, who under present law is supposed to regulate bridge tolls, has his duty made more specific in this bill. It prescribes that toll rates shall not exceed an amount covering operation, maintenance, and 10 per cent return on actual cost. Amortization is not mentioned in the bill.

JOINT study of the Rio Grande and Colorado River by an international commission is provided for in a resolution just introduced in the House. A law of 1924 provides for international study of the apportionment and use of the waters of the Rio Grande, but the Mexican government has expressed itself as "disposed to agree to have one commission deal with both rivers." The resolution accordingly provides for such joint study, to obtain data on which a treaty between the governments may be based.

Detroit Electors to Vote on Two Subway Lines

Proposals for two subway lines, the construction cost of which is estimated at $92,211,100, will be submitted to the electors of the city of Detroit at the regular election April 4, 1927. The two lines to be voted on first are the Woodward Ave. line and the Grand River-Gratiot line, the former route being 7.8 miles and the latter 13.8 miles of double track. The estimated cost of construction per route-mile is approximately $4,250,000 and the estimated cost of equipment is $42,749,000, or approximately $1,970,000 per route-mile.

The type of construction for all underground lines would be a combination of tunnels and subways.

The Rapid Transit Commission under whose direction the plans were prepared is comprised of Sidney D. Waldon, Andrew H. Green, Jr., Col. H. W. Alden, Clarence W. Hubbell and Willard Pope. John P. Hallihan is engineer, and Daniel L. Turner, New York City, consulting engineer for the commission.

Double-Deck Bridge for Toledo

In connection with the replacement of the Toledo Terminal R.R. bridge over the Maumee River at Toledo, Ohio, by a double-track structure, which is expected to be undertaken within a year or two, a proposition has been made to have a double-deck structure with a highway on the upper deck. Whether this plan can be carried out depends upon whether the city and county can finance their shares of the cost and complete their arrangements in time to meet the plans of the railroad company. A swing span will cross the navigation channel.

South Philadelphia Bridge Fund Bills in Legislature

Bills in the Pennsylvania State Legislature propose to appropriate $750,000 to begin construction of a bridge over the Delaware River between South Philadelphia, in the neighborhood of South Broad St. and a point near Red Bank, on the New Jersey shore. Promises have been received from representatives of the New Jersey Legislature that the latter state would match any sums appropriated for this structure by Pennsylvania. The bridge, it is contended, would relieve the traffic congestion at the Camden bridge, opened last July.

Ley to Build Florida Bridge

Contract was let on Feb. 9 to Fred T. Ley Co. for construction of the Shands bridge over the St. Johns River at Green Cove Springs, Fla., about 30 miles from Jacksonville, half way to Palatka. The structure is to be about 10,000 ft. long and will carry a 20-ft. roadway. It is wholly of creosoted pile trestle construction with timber floor of laminated construction, except for a 100-ft. single-leaf Strauss bascule span over the navigation channel.

Random Lines

A Few More

(213) *Civilization Engineers*—"This is the only fitting term for the representatives of forty-five learned societies who gather under the auspices of the American Association for the Advancement of Science"—Editorial in Philadelphia *Evening Bulletin.*

(214) *Rolling Pin Engineers* — "Couldn't you make it a little longah Jedge?" inquired Jacob Lewis, an extremely ebony little negro after he had been sentenced to 30 days in the workhouse.

"Why do you want a longer term?" asked Justice Direnzo.

"Well, Jedge," said Jacob, "I spent six months on de island last yeah and dey was jest de peacefullest six months. Mah wife is one o' dem rollin' pin engineers, Jedge. I suttinly am happier in jail dan when she is operatin' on me."—New York *Times.*

(215) *Vital Engineering* — "Vital engineering relieves constipation, headache, backache, sciatica, lumbago, rheumatism, coughs, colds, etc. Quickly relieves tonsilitis and neuritis. Colonic irrigations also given. Write for booklet or phone Maine 2136, Institute of Vital Engineering, Inc., 1410 H st. n.w."—Ad. in Washington *Star.*

(216) *Directory Engineers* — "Telephone directories," says the Bell System, "have been under study by Directory Engineers for several years."

(217) *Wet Engineer* — Epithet applied to Howard Ferguson, the newly installed premier of not-so-dry Ontario.

* * *

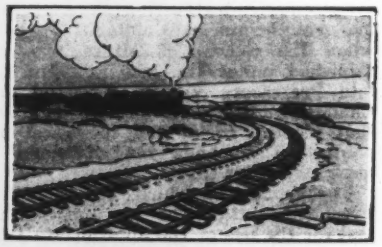
The "Bandit" Engineer!!

Kansas City—Thieves broke into the city water plant last night and carried away the 600-lb. booster pump that is a vital part of the Raytown water system.

* * *

Headed For Trouble

Sir—In the accompanying sketch, there may be only an optical illusion in the case of the track already placed in service, but it looks to me as though the extreme sharpness of the curve,



(apparently made necessary only by the desire of the passengers to keep in sight of the river) had forced the adoption of a completely new principle, the super-elevation of the inside rail.

H. S. D.

Personal Notes

E. B. FITHIAN has been appointed division engineer for the Wichita division of the Missouri Pacific R.R. He succeeds L. Winship, who goes to Hoisington, Kan., as assistant division engineer.

JOHN BERG, state engineer of South Dakota, Pierre, S. D., was re-elected president of the South Dakota Society of Engineers and Architects at the recent convention at Aberdeen, S. D.

GEORGE H. FERGUSON has been appointed by the Canadian Department of Health as chief sanitary engineer for the provinces of Ontario and Quebec.

GERALD C. FITZGERALD who has for seven years been associated with Leeds & Barnard, consulting engineers, Los Angeles, Calif., has resigned from that firm to become associated with the Fitz-Gerald Engineering & Construction Co., Pacific Mutual Building, Los Angeles.

R. A. THOMPSON, consulting engineer, Dallas, Texas, has been appointed engineer of the Texas State Highway Commission, with headquarters at Austin, Texas. He formerly served as chief engineer of both California and Texas railroad commissions, and as member of the engineering board, bureau of valuation, Interstate Commerce Commission, from 1913 to 1921, having charge of the Pacific district office at San Francisco. He recently constructed a large reservoir dam and an irrigation system at Wichita Falls, Texas, and the Garza dam at Dallas, Texas, which is now being completed under his direction.

W. D. WIGGINS, whose promotion to be chief engineer of the Central Region of the Pennsylvania Railroad System at Pittsburgh, Pa., was announced in these pages Feb. 3, p. 210, was born at Richmond, Ind., April 28, 1873. He received his engineering education at Rose Polytechnic Institute, where he graduated in 1895. The same year he entered the service of the Pennsylvania Railroad on the Logansport Division, where he occupied various positions in the engineer corps, until in July, 1899, he was appointed assistant division engineer. Subsequently he was division engineer on various divisions of Lines West of Pittsburgh, then superintendent of the Peoria Division, valuation engineer of the Pennsylvania Lines west of Pittsburgh, and finally chief engineer, maintenance-of-way of the Central Region, which position he held until in April, 1926, he was appointed assistant chief engineer.

RUSSELL S. GREENMAN, Albany, N. Y., formerly senior assistant engineer, specializing in concrete and testing of materials, Department of State Engineer, state of New York, announces the opening of an office in Albany for the practice of concrete engineering and of a laboratory for the inspecting and testing of structural materials, the office being at 444 Broadway and the laboratory at 40 Manning Boulevard in Albany. The practice will include making specifications, designing and checking plans on concrete structures, designing concrete proportioning, waterproofing, inspection of cement and other materials in field or at mill, and similar service leading to betterments in making concrete or in the finished material. Mr. Greenman has had long experience in the testing of material and inspection of structures for the state, especially in connection with the New York State Barge Canal. For some years he was chairman of Committee C-1, on Cement, of the American Society for Testing Materials.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1927.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton, N. J.; Annual Meeting, Atlantic City, N. J., Feb. 16-18, 1927.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual meeting, Chicago, Ill., Feb. 22-24, 1927.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 8-10, 1927.

AMERICAN WELDING SOCIETY, New York; Annual meeting, New York City, April 27-29.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Chicago, Ill., May 9-12, 1927.

The Chicago Association of Consulting Engineers, whose membership is composed of mechanical, electrical and sanitary engineers acting wholly in a consulting capacity, has elected officers as follows for 1927: President, Irving E. Brooks; vice-president, Ernest V. Lippe; secretary, Rollo E. Gilmore, 104 So. Michigan Ave., Chicago.

The Engineers Club of St. Louis announces a series of five addresses on the labor question, as follows: March 2, "The Economics of Labor," Professor Lippincott; March 10, "Labor and Mining," Arthur Thacher; March 18, "Labor and the Municipality," E. E. Wall; March 24, "Labor and Building," A. P. Greensfelder; March 31, "Labor and Manufacturing," J. L. Hamilton.

The Rocky Mountain Section, American Water Works Association held its first meeting in Denver on Feb. 7, and was presided over by Paul E. Strouse, city engineer, Rocky Ford, Colo., who was elected as section chairman for 1927-28. Among the papers read were "Methods and Cost of Softening Water," by William M. Barr, consulting chemist, Union Pacific R. R., and "Well Water Problems," by Paul S. Fox, sanitary engineer New Mexico Bureau of Health. Samuel A. Greeley, consulting engineer, Chicago, spoke on sewage treatment. Moving pictures of a sewage-works were shown by a representative of the Portland Cement Association. Water-works legislation was discussed by D. E. Kepner, sanitary engineer, Colorado Board of Health.

Obituary

JOHN W. WESTON, a retired engineer who formerly lived in Chicago and was publisher of the *American Engineer*, died Feb. 1 in Oklahoma City. At the time of the Chicago exposition, Mr. Weston organized and carried through a congress of engineers.

ROBERT B. ROBINSON, engineer of maintenance-of-way of the Union Pacific R.R., died Feb. 1 at a hospital in Omaha, Neb., from blood poisoning, at the age of 48 years. Mr. Robinson was a native of Pennsylvania and received his engineering education at the University of Illinois. He entered the service of the Union Pacific in 1899 as rodman on the Kansas Division. In 1904 he went to the Oregon Short Line unit of the Union Pacific system and by 1916 had become engineer of maintenance-of-way of that road. In 1919 he became engineer of maintenance-of-way for the Union Pacific system, with headquarters at Omaha.

COL. W. P. ANDERSON, formerly chief engineer in the Marine and Fisheries Department of the Canadian Government, died at his home in Ottawa, Ontario, Feb. 1, aged 76 years. Colonel Anderson's connection with the department of Marine and Fisheries commenced in 1874 when he secured a position as draftsman. In 1880 he was appointed chief engineer of the department, and superintendent of lighthouses, which position he held until his superannuation in 1919. During his years of experience with marine work he became one of the best known authorities on lighthouse engineering and construction. While in office he constructed 360 lighthouses and 50 mechanical fog signals in Canadian waters.

EDGAR A. JAMES, a prominent civil engineer of Toronto, Ont., died on Feb. 10, after an illness of some months, at the age of 52 years. He was born at Thornhill, Ont., and graduated at the University of Toronto in 1905 with the degree of B.Sc. He was elected a senator of the Toronto University in 1906 and later became president of the Toronto branch of the Canadian Society of Civil Engineers. Mr. James was a member of the York Roads Committee in which capacity he had to plan all the roads around Toronto. He accumulated a vast amount of historical data concerning the early settlement of the province, particularly in relation to road construction.

COL. HERBERT B. MAXSON, former county surveyor of Washoe County, Nevada, and former deputy U. S. surveyor for Nevada, for eight years secretary of the National Irrigation Congress, died in Los Angeles, Cal., Jan. 27, aged 77. He was born in Leonardsville, N. Y.

CAPT. FRANK S. INGALLS, former state surveyor general and former city engineer of Yuma, Ariz., died Jan. 18, aged 76.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

Darnall Patent for Chlorinating Water and Sewage Upheld

Claims 1, 2 and 4 of the Darnall patent for a process of purifying water or sewage by means of dry chlorine gas has been upheld by Judge John R. Hazel of the District Court of the United States for the Western District of New York in a suit brought against the Village of Le Roy, N. Y., by the Wallace Tiernan Co., Inc. The Paradon Engineering Co., which installed the chlorinator at Le Roy, has been made a contributory infringer. The patent in question was No. 1,007,647, dated Oct. 31, 1911, granted to Carl R. Darnall, and is owned by the plaintiff. Of the four claims of the plant Nos. 1, 2 and 4 were involved. These cover the introduction to water or sewage "of minute quantities of dry chlorine gas"; "uniform pressure and maintaining a constant relation between the volume of gas and the volume of the water"; and "establishing a supply of dry chlorine gas under high pressure and admitting said gas to the liquid to be treated under a uniform low pressure."

The Darnall patent has about a year and 9 months yet to run.

Sand and Gravel Producers Hold Annual Convention

A very successful convention of the sand and gravel industry was held in Cincinnati Jan. 17-19, when the eleventh annual meeting of the association was held. The program consisted of a well-balanced group of papers and an exhibit of machinery by 55 companies furnishing equipment for the sand and gravel industry. About 350 persons registered. The first day of the convention was devoted to meetings of the Board of Directors and of the committee on Specifications for Standardized Sizes of Sand and Gravel. Considerable attention was given by the board to plans for the expansion of the engineering and research division of the association, and a meeting will be held of the board in Chicago June 21 to give more consideration to these plans. The committee on Specifications for Standardized Sizes of Sand and Gravel took steps to establish this committee as a standing committee.

Of particular interest were papers by G. S. Brown, president of the Portland Cement Association, on the value of industrial associations; by Prof. D. A. Abrams on the value of industrial research; and by Edwin Brooker of Washington, D. C., on the desirability of sand and gravel traffic to the railroads. One entire session of the convention was devoted to papers on the design of sand and gravel plants. They were presented by Frank W. Welch, chief engineer of the Greenville Gravel Corporation; Gordon Smith, secretary, J. C. Buckbee Co., engineers; Albert E. Reed of the W. S. Tyler Co.; and Fred W. Cornuelle of the Red Bank Gravel Co.

Officers elected were: President, Hugh Haddow, Jr., Millville, N. J.; vice-president, H. H. Halliday, Cairo, Ill.; and secretary-treasurer, Earl Zimmerman, Cincinnati, Ohio.

Air Pump Company Bought

Announcement is made by the Worthington Pump & Machinery Corporation of the purchase by it of the Harris Air Pump Co. of Indianapolis, Ind., for some years one of the foremost manufacturers of air lift systems and air lift pumps. The purchase was outright and includes patents, drawings, patterns, and good will. This acquisition permits the company to offer complete well equipment, including compressors, produced in its own plant.

Concrete Pavement Yardages

There is given below tabulation of concrete pavement yardage awarded during January, 1927, together with the total number of square yards awarded in roads, streets and alleys for the year to Jan. 29, 1927. These figures represent awards in the United States only.

	Square yards awarded during Jan. 1927	Square yards awarded from Jan. 1, 1927 to Jan. 29, 1927
Roads	2,656,118	2,656,118
Streets	1,504,059	1,504,059
Alleys	75,352	75,352
Totals	4,235,529	4,235,529

Business Notes

AMERICAN PAULIN SYSTEM, INC., has obtained exclusive manufacturing and selling rights for Paulin System instruments in North and South America, China and Japan. The company is moving into a new three-story building at First and Folsom Sts., San Francisco. A/B Navigator of Stockholm, Sweden, is the parent company, owning all patents on Paulin instruments. The man formerly in charge of production at the Sweden plant will take charge of production in the San Francisco plant. George H. Eberhard is president, and H. E. Linden, vice-president and general manager of the company.

JOSEPH S. HELM, manager of the asphalt sales department of the Standard Oil Co. of Louisiana, has been made general manager of asphalt sales at home and abroad for the Standard Oil Co. of New Jersey. C. G. SHEFFIELD, until recently in charge of the asphalt department of the Standard Oil Co. of New Jersey, was placed in charge of sales in the lubricating department. Mr. Helm was graduated from Kentucky University. After seven years with the Chesapeake and Ohio R.R. in various engineering capacities, he became associated with the Standard Oil Co. of Kentucky, then going to the New Jersey company with Atlanta, Ga., as headquarters, ultimately locating at New Orleans with the Louisiana company.

FOOTE CO., INC., of Nunda, New York, has been awarded a gold medal and diploma in recognition of twenty-five years of public service by the American Institute of New York. This is the first recognition that has ever been given to a piece of road machinery by this organization.

HYATT ROLLER BEARING CO., Newark, N. J., through H. J. Forsythe, president, announces the appointments of H. O. K. Meister as general sales manager and A. W. Scarratt as chief engineer. Mr. Meister joined the Hyatt forces more than fourteen years ago, locating first as an engineer at the home office in Newark. Later he was transferred to the Chicago office and, after a few years took over the supervision of Hyatt sales work in the western territory. Eighteen months ago, he was appointed assistant sales manager and remained at Newark.

BAY CITY DREDGE WORKS, Bay City, Mich., announces the following new sales representatives:

Shreveport Machinery Sales, 927 Giddens-Lane Bldg., Shreveport, La.; Burress-Clark Machinery Co., Tampa, Fla.; Construction Equipment Co., 437 E. Bay St., Jacksonville, Fla.; Mills-Lupton Supply Co., Chattanooga, Tenn.; John Mattison, Blytheville, Ark.; Leigh M. Railsback, 115 So. Los Angeles St., Los Angeles, Cal., and H. F. Saxton, Clinton, Iowa.

BENJAMIN NIKOLAS BROIDO, chief engineer of the industrial department of the Superheater Co., of New York and Chicago, died suddenly at his home in New York, Feb. 10, 1927. Mr. Broido was known throughout this country and abroad as a designer of exceptional ability of steam superheaters and heat exchange apparatus. Mr. Broido was born in Wilna, Russia. His early education was obtained in Germany, and he was graduated in 1904 from Frederick's Polytechnic, Gothen, Germany, with a degree in mechanical engineering. For the next two years he was an instructor at the Polytechnic. Mr. Broido came to this country in 1914 and took a post-graduate course in the City College of New York and Columbia University. Later he became connected with the Roessler and Hasslacher Chemical Co., Perth Amboy, N. J., for whom he designed power plants. In 1917 he was engaged by the Philadelphia and Reading Railway Co. to design a power and creosoting plant. At the end of 1917 he became connected with The Superheater Co. as designing engineer in charge of design and development of Elesco superheaters for stationary boilers.

New Publications

Mixers—AMERICAN CEMENT MACHINE CO., Keokuk, Iowa, has just published a 24-p. illustrated booklet describing its Boss mixers, pavers and hoists. The booklet explains the special adaptability which each one of the machines possesses. A blueprint giving general specifications, shipping information and dimensions is a feature of the booklet.

Portable Asphalt Plants—CHAUSSE OIL BURNER CO., Elkhart, Ind., has explained, in a recently-published 20-p. booklet, some performance data on its portable asphalt plants. The booklet contains full and detail views of the plants together with specifications.

Dust Collectors—CYCLONE BLOW PIPE CO., Chicago, Ill., issues its Bulletin No. 26 on dust-collecting systems. Photographic details of all parts and a blueprint showing a complete installation are featured.

Crushers—TRAYLOR ENGINEERING & MFG. CO. of Allentown, Pa., has issued Bulletin 2097 which supercedes J-2 and 1097. The booklet which comprises 34 pages explains in detail the design of its types A, B, C, D and F jaw crushers.

Cement—In an 8-p. color booklet MARQUETTE CEMENT MFG. CO., Chicago and Memphis, has given some valuable pictorial information on winter concreting. The book amplifies other information which the company has issued on the same subject.

Tractors—MONARCH TRACTOR CORPORATION, Springfield, Ill., has just issued an 8-p. booklet giving complete description and specifications of its new 10-ton tractor.

Power Shovel—Data on its new Models 2 and 3 power shovels are given in a booklet recently issued by Northwest Engineering Co., Chicago. A description of these two new models was included in *Engineering News-Record*, Feb. 10, p. 260.

Road Machinery—The GALION IRON WORKS & MFG. CO., Galion, Ohio, has issued a 96-p. catalog descriptive of its heavy and light rollers, its graders, drag plows and miscellaneous contractor's equipment. The catalog is well illustrated and its generous typography makes it easy to read.

Turbo-Generators—In a 48-p. booklet, attractively illustrated in sepia, American Brown Boveri Electric Corporation of Camden, N. J., has given design and installation data on steam turbo-generators. The book also contains some excellent photographs of a number of actual installations of both small and large units.

Motor Trucks—National Automobile Chamber of Commerce, 366 Madison Ave., New York, N. Y., has just issued the 1927 edition of its annual "Handbook of Automobiles," including data and specifications for 56 commercial cars and motor trucks in addition to 105 passenger cars and 13 motor buses. Copies of the handbook may be had at a cost of 50c.

Wood Stave Pipe—PACIFIC TANK & PIPE CO., San Francisco, devotes the 70 pages of Catalog No. 17 to its wood stave pipe. The catalog is written in the form of a description of wood pipe practice on municipal supply lines for fire protection, irrigation systems, reclamation work, hydro-electric power development, sewage disposal, railroads, chemical plants, etc. Information is included on pressure installations, etc., and in the back of the book specifications and manufacturing practices are given.

1927 *Solar Ephemeris*—A LIETZ CO., San Francisco, has made available a small booklet concerning solar ephemeris data for 1927. Azimuths of Polaris are given up to 1930. Information is also given on the method of computing sun declinations by means of the tables, and also on the method of obtaining the true meridian.

Rock Asphalt—The Kentucky Rock Asphalt Co., of Louisville, Ky., has just issued a 16-page illustrated booklet explaining the uses to which Kyrock may be put in railroad construction and maintenance. The book is illustrated with examples of the use of rock in grade crossings, guard crossings, terminal layouts, etc. Data on the quarrying and preparation of Kyrock are included in the booklet.

Manufacturers and Trade Associations

Calendar

Annual Meetings

COMMON BRICK MANUFACTURERS ASSOCIATION, Cleveland; Annual meeting, Chicago, Feb. 21-26, 1927.

NATIONAL BATTERY MANUFACTURERS' ASSOCIATION, New York; Annual meeting, Philadelphia, March 11 and 12, 1927.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Annual Meeting, White Sulphur Springs, West Va., March 21-23.

SOUTHERN PINE ASSOCIATION; New Orleans; Annual meeting, New Orleans, March 22-23.

HYDRAULIC SOCIETY, New York; Annual meeting Chicago, March 25, 1927.

WATERWORKS MANUFACTURERS ASSOCIATION, New York; Annual meeting, Chicago, June 6-10.

The Concrete Reinforcing Steel Institute, at its annual meeting at White Sulphur Springs, W. Va., on March 21 to 23, is to have the following papers: "Who is Responsible," by H. J. Burt, consulting engineer, Chicago; "Mill Competition," by C. F. Abbott, American Institute of Steel Construction; and "Business Broadcasting," by J. W. Gorby, Chicago.

The Asphalt Association during its recent convention in Chicago, in January, elected the following officers: President, Joe S. Helm, general manager of asphalt sales for the Standard Oil Company of New Jersey; vice-president, Leroy M. Lee, New Orleans Refining Co.; treasurer, Herbert Spencer, Standard Oil Company of New Jersey; and secretary-general manager, New York City.

New Developments

New Leaning-Wheel Grader Based on New Design

The outstanding feature of a new leaning-wheel grader recently announced by the Galion Iron Works & Mfg. Co., Galion, Ohio, is the pivotal frame adjustment which accomplishes the same purpose as a frame side shift on the rear axle. The pivotal adjustment however, is claimed to make the shift with a minimum of effort and in addition strengthens this part of the grader. The device consists of two heavy parallel bars attached at their front ends to the frame of the grader, with a jaw at the rear extending over the axle and attached to it by a vertical bolt. The rear end of each side of the frame of the grader rests and slides on strong electric steel segments made as integral parts of the pivotal bars.

An advantage worthy of mention is the fact that when the frame is adjusted to the extreme right or left, the pivotal bars act as a diagonal brace for the extended rear axle. The above illustration gives some idea of the rear axle construction. The bearings of the grader are machine fitted and the company's E-Z lift gearing is used for moving the mouldboard.

Alkalinity and Acidity Control by Hydrogen-Ion Determination

During the past few years determination and control of acidity and alkalinity by means of hydrogen-ion measurement has been steadily growing in industrial, medical and bacteriological work. The LaMotte Chemical Products Co., Baltimore, Md., has recently issued a catalog entitled "The A B.C of Hydrogen-Ion Control," which gives in an excellent manner the theory, the present status and a number of the results that have been obtained. The catalog discusses separately the various industries in which the hydrogen-ion scale schowing pH values is used. These applications include water purification, sewage dispcsal, sugar refining, alkalinity in clays, industrial wastes, electropiating, bacteriological

work, etc. The catalog is completed by descriptions of the company's equipment for the determination of hydrogen-ion concentration by colorimeters.

Bucket with Rectangular Bowl for Light Crane Work

For trench digging and general excavation with light crawler mounted and motor truck mounted cranes, the George Haiss Mfg. Co., New York City, is introducing a small narrow-bowl rope-reeved grab bucket. It is claimed that the rectangular shaped bowl has one advantage over bowls somewhat more square. This advantage is that the digging power is directly proportioned to the length of the distance from the corner hinge to the center pivot. For this reason, it is said that the digging power of a big bucket is obtained

with this light-weight, ½-yd. bowl. Features of the bucket are heavy round-forged connecting rods, large-diameter sheaves, and sturdy bowl bracing. The lower sheaves are made particularly heavy in order to do away with the need for counterweights.

Power Dipper Trip for Gasoline Shovels

Believing that one man can coordinate all the movements of a shovel better than can two, the Koehring Co., Milwaukee, has developed a power dipper trip as optional equipment on its heavy-duty gasoline shovels. The operator can thus trip his dipper at the exact instant it reaches the desired place, a factor which is claimed to definitely speed up operations. The dipper trip is so constructed that the lever operating it can be moved with one finger. Power for the trip cable is obtained by placing a small drum, with heavy brake lining on the outside, on the end of the rear drum shaft. A second steel drum, polished on the inside and placed over the first drum, turns when there is sufficient friction between the two. The trip cable is attached to the outside drum and the operator controls the friction with a lever as previously noted.

Business Side of Construction

Facts and Events that Affect Cost and Volume

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Feb. 17, 1927	$14,594,000	$35,503,000	$50,097,000
Feb. 10, 1927	8,145,000	40,807,000	48,952,000
Feb. 18, 1926	17,926,000	38,562,000	56,488,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
Jan. 1 to Date			
1927	97,147,000	222,435,000	319,582,000
1926	111,566,000	221,719,000	333,285,000

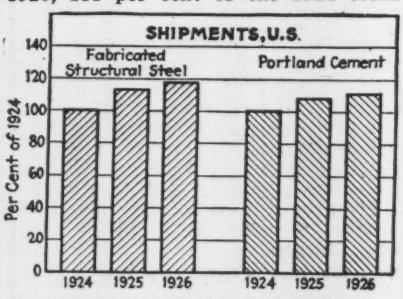
Steel Gains More Abrupt Than Those of Cement

Shipments of Fabricated Structurals and Portland Cement Compared—Decline in Bookings

THAT the yearly gains in demand for building steel have been greater than that for portland cement, is shown by the accompanying graph of shipments in both materials during the last three years, for the United States.

Taking 1924 as 100, since it was the first full year for which shipment figures on fabricated structurals were available, it is found that in the case of the steel, 1925 deliveries were 113 per cent and 1926, 117 per cent of the 1924 volume.

Portland cement shows 1925 shipments at 108 per cent and those of 1926, 111 per cent of the 1924 total.



YEARLY INCREASE GREATER IN STEEL THAN IN CEMENT

Actual figures on mill shipments follow: fabricated structural steel, tons, 1924, 2,411,390; 1925, 2,723,650; 1926, 2,836,000—portland cement, barrels, 1924, 146,048,000; 1925, 157,295,000; 1926, 161,781,000.

Bookings of fabricated structural steel in 1926 totaled 2,532,000 tons, against 2,735,400 in 1925, a drop of 7 per cent. The gain in shipments shows actual consumption but this applies only to the peak year 1926. The decline in bookings is the thing that may indicate a contraction in total construction volume for the current year.

Cement production in all of the nation's mills aggregated 164,057,000 bbl. for 1926, compared with 161,659,000 in 1925.

Steel ingot output for January, 1927, all companies, totaled 3,806,888 tons. This represents a slight increase over December but is also the smallest January tonnage in the last three years. At any rate, ingot production is nearly 9 per cent above the January average for the last six years.

The situation in cement, just at the present time, seems more favorable than that of steel, since the former shows gains in output and demand while the latter is weakening in the direction of bookings even though production and shipments on old orders continue brisk.

The minimum price of steel shapes is 5 per cent lower than it was two weeks ago, while cement has declined not quite 3 per cent during the last month.

Figures on structural steel sales and shipments are from the Bureau of the Census, those on cement output and shipments from the Bureau of Mines, and steel ingot output from the American Iron and Steel Institute.

Nation's Fifty Biggest Construction Jobs Of 1926 Total $360,000,000

Over 29 Per Cent of This Money Invested in New York City—Chicago Gets 12 Per Cent

FIFTEEN of the fifty largest projects on which contracts were awarded during 1926, were located in New York City. Chicago accounts for nine of the number, while the remaining twenty-six were scattered, as shown by the accompanying map.

Over 75 per cent of the country's largest jobs are found in that section embracing Illinois, southern Michigan, Ohio, Pennsylvania, northern Maryland, New Jersey, the New York district, and southern New England. This is a comparatively narrow strip to hold such a large percentage of the nation's biggest projects.

The placing of the minimum value at $4,000,000 affords a list of just fifty lettings, at that figure and above, out of the year's total for all construction.

A money value comparison is of little value here, since a single project, the Conowingo (Md.) power plant, represents 14 per cent of the total value of the fifty contracts.

The fifteen New York City lettings amounted to $106,498,022 or 29 per cent of the total, while the nine at Chicago came to $42,100,000 or 12 per cent of the value of the fifty largest contracts.

The following diagram shows the approximate location of each project.

WHERE NATION'S FIFTY BIGGEST JOBS ARE LOCATED

Fifty Largest Projects Awarded in the United States During 1926 and the Contractors Who Handled Them

	Nature of Job	Location	Contract Let By	Contractor	Amount
1.	Power plant	Conowingo, Md.	Susquehanna Power Co.	Stone & Webster, Boston, Mass.	$52,000,000
2.	Subway	New York, N. Y.	Board of Transportation	Rosoff Constr. Co., New York, N. Y.	14,150,000
3.	Railway	Ohio	Chesapeake & Hocking Ry. Co.	Fritz-Rumer Cook Co. and others, Columbus, O.	12,500,000
4.	Power plant	Badin, N. C.	Tallahassee Power Co.	Southern Power Co., Charlotte, N. C.	12,000,000
5.	Bridges	Arthur Kill, N. Y.-N. J.	Port of New York Authority	Substructures: P. J. Carlin Constr. Co., N. Y. C. $1,386,100; Triest Construction Co., N. Y. C. 946,750; Frederick Snare Co., N. Y. C. 1,909,960 and 1,350,620; Superstructures: McClintic Marshall Co. N. Y. C. 2,599,150; Bethlehem Steel Co., N. Y. C. 1,888,269	10,080,846
6.	Office building	New York, N. Y.	New York Life Insurance Co.	Starrett Bros., Inc., New York, N. Y.	10,000,000
7.	Office building	New York, N. Y.	Bricken Construction Co.	By separate contract	10,000,000
8.	Power plant	Chelan Falls, Wash.	Chelan Elec. Co.	Grant Smith & Co., Seattle, Wash.	10,000,000
9.	Office, showrooms	New York, N. Y.	A. N. Adelson, Inc.	Shroder & Koppel, Inc.	9,000,000
10.	Subway	New York, N. Y.	Board of Transportation	Oakdale Contracting Co., Long Island City, N.Y.	8,839,672
11.	Depot	Cleveland, Ohio	Cleveland Union Terminal Co.	J. Gill & Sons, Cleveland, Ohio	8,000,000
12.	Dam	Pedee River, N. C.	Carolina Power & Light Co.	Hardaway Contracting Co., Columbus, Ga.	8,000,000
13.	Office building	New York, N. Y.	H. I. Chanin	By separate contracts	8,000,000
14.	Arena	Jersey City, N. J.	Journal Sq. Gardens, Inc.	Thompson-Starrett Co., New York, N. Y.	7,000,000
15.	Cathedral of Learning	Pittsburgh, Pa.	University of Pittsburgh	Stone & Webster, Boston, Mass.	7,000,000
16.	Subway	New York, N. Y.	Board of Transportation	Heyman & Goodman Co., Inc., New York, N. Y.	6,641,678
17.	Office building	San Francisco, Calif.	E. H. Rollins & Sons and S. W. Coleman	Dinwiddie Constr. Co., San Francisco, Calif.	6,500,000
18.	Oil pipe line	Texas	Magnolia Petroleum Co.	Company forces	6,500 000
19.	Office and store	Chicago, Ill.	E. Jackson	Starrett & Dilks Co., Chicago, Ill.	6,100,000
20.	Power plant	Union, Pa.	West End Power Co.	Sanderson & Porter, New York, N. Y.	6,000,000
21.	Library	New Haven, Conn.	Yale University	Marc Eidlitz & Sons, New York, N. Y.	6,000,000
22.	Hotel	Houston, Tex.	R. S. Sterling	D. Hall, Houston, Tex.	6,000,000
23.	Gas pipe line	Texas and Colorado	Lone Star Gas Co.	Company forces	6,000,000
24.	Office building	New York, N. Y.	M. Natanson	G. Richard Davis, New York, N. Y.	6,000,000
25.	Loft and office building	New York, N. Y.	C. G. Edwards Syndicate	G. Richard Davis, New York, N. Y.	6,000,000
26.	Loft and office building	New York, N. Y.	Merchants Square Corporation	G. Richard Davis, New York, N. Y.	6,000,000
27.	Subway	New York, N. Y.	Board of Transportation	G. H. Flinn, New York, N. Y.	5,026,608
28.	Plant	Pontiac, Mich.	General Motors Corp., Detroit, Mich.	Austin Co., Detroit, Mich.	5,000,000
29.	Warehouse, compress	Houston, Tex.	Manchester Terminal Corp.	By day labor	5,000,000
30.	Office and store	Chicago, Ill.	Marshall Field Estate	Henry Ericsson Co., Chicago, Ill.	5,000,000
31.	Theatre, hotel, store	Chicago, Ill.	A. Karsas	Longacre Constr. Co., Chicago, Ill.	5,000,000
32.	Theatre and office building	Chicago, Ill.	23 W. Monroe St., Corp.	J. A. Holpuch Co., Chicago, Ill.	5,000,000
33.	Office building	Detroit, Mich.	J. J. Barlum	Otto Misch Co., Detroit, Mich.	5,000,000
34.	Convention hall	Atlantic City, N. J.	Board of City Commissioners	Consolidated Eng. Co., Baltimore, Md.	4,686,000
35.	Subway	New York, N. Y.	Board of Transportation	La Rocca Constr. Co., New York, N. Y.	4,680,064
36.	Administration building	Massapequa, N. Y.	Deauville Estates, Inc.	T. C. Desmond & Co., Inc.	4,500,000
37.	Office and store	Chicago, Ill.	Michigan-Lake Building Corp.	Paschen Bros., Chicago, Ill.	4,500,000
38.	Office building	Chicago, Ill.	Medical Arts Club	Thompson-Starrett Co., Chicago, Ill.	4,500,000
39.	Subway	New York, N. Y.	Board of Transportation	Moranti & Raymond, New York, N. Y.	4,160,000
40.	Auction sale building	Philadelphia, Pa.	B. & O. R.R. Co. and Reading Co.	United Gas & Improvement Co., Phila., Pa.	4,000,000
41.	Office and loft	New York, N. Y.	A. Adelson	Shroder & Koppel, Inc., New York, N. Y.	4,000,000
42.	Theatre and office building	Kansas City, Mo.	Loews, Inc.	By separate contract	4,000,000
43.	Store and office	Los Angeles, Calif.	Sun Realty Investment Co.	J. V. McNeil Co. Los Angeles, Calif.	4,000,000
44.	High school	Chicago, Ill.	Board of Education	Paschen Bros., Chicago, Ill.	4,000,000
45.	Bank and office building	New Orleans, La.	Canal Bank & Trust Co.	O. W. Gwin Constr. Co., New Orleans, La.	4,000,000
46.	Gas supply line and distribution system	Texas	Texas Gas Co.	Connor Constr. Co., Kansas City, Mo.	4,000,000
47.	Office, loft and store	New York, N. Y.	Park Ave. & 33rd St. Corp.	Shroder & Koppel, Inc., New York, N. Y.	4,000,000
48.	Club, store and office	Chicago, Ill.	K. M. Vitzthum & Co.	Duffy-Noonan Constr. Co., Chicago, Ill.	4,000,000
49.	Theatre	Pittsburgh, Pa.	Stanley Rowland Clark Corp.	W. T. Grange Constr. Co., Pittsburgh, Pa.	4,000,000
50.	Office and garage	Chicago, Ill.	Building Constr. Employers' Assoc.	J. Griffiths & Son Co., Chicago, Ill.	4,000,000
	Total				$360,364,871

Weekly Construction Market

THE downward movement in prices of construction materials in the principal cities, while it continues unchecked, has begun to show signs of reaching a standstill in the not distant future. Spring building demand will at least inject an element of firmness into the situation.

Of the 4,524,748 carloads of revenue freight hauled by the railroads of the country during the first month of the current year, at least 1,100,000 contained building materials. Even a rough estimate reveals a heavier volume of materials going into construction than during the corresponding periods in 1926 and 1925.

Increased buying of railway and automotive steel characterizes the present market in these materials. Tin plate movement is also active. Copper recently hit the lowest levels touched during the last three years; slight improvement in commitments in the last week, however, threaten to bring quotations a trifle higher.

Pig-iron tends downward, carrying with it steel products such as wire, reinforcing bars, structural shapes, plates, sheets, strips, and semi-finished material.

Reinforcing bars are $1.90@$2 per 100 lb., at Pittsburgh mill; shapes and plates bring $1.90, with mention of $1.80 per 100 lb. The total decline in these three products, since the first of the month is about 10c. per 100 lb. at mills; warehouse quotations remain unchanged.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.00	$3.15	—$3.80
Structural rivets, 100 lb.	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	2.75	2.30@2.50	2.87½	3.87½	2.95	3.10	3.57
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	54.25%	41%	42@53.8%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	47.60	42.75	56.00	45.20	48.50	—62.00	47.00	55.00	62.50
Concreting Material									
Cement without bags, bbl.	2.35@2.55	2.35	2.05	2.05	2.22	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.85	1.65	1.90	1.80	1.25	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.56	1.25	1.00	1.40	1.25	+1.35
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61@63	34.00	56.00	40.00	39.25	32.75	27.00	25.00	50.00
Lime, finishing, hydrated, ton	18.20	23.50	19.00	20.00	25.50	24.00	25.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3.00	1.50	1.82	1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.076	.076	.075	.....	.09	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	.076	.076	.075	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	—.84	.90¾	1.10	.85	—.93¾	1.07	.91	1.12	—1.03
Common Labor									
Common labor, union, hour	.90⅝	.30	.....	.90	.....	.50@.55	.60	.62½	— .....
Common labor, non-union, hour	.....	.25	.30@.50	.....	.45@.60	.40@.45	.50	.....	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Feb. 3, the next on Mar. 3.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) carlots; shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.84). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, in carload lots.

Unit Prices

For actual prices bid on materials in place at various construction jobs throughout the country, see pp. 111-112 of this issue, following Construction News.

On Feb. 1, 1927

E. N.-R. Construction Cost Index Number 210.15

E. N.-R. Construction Volume Index Number 187

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month